7. Assessment of key issues

This chapter provides an assessment of the key environmental issues for the project as identified in the SEARs and as per the relevant requirements of Schedule 2, Part 3 of the EP&A Regulation. **Table 7-1** outlines the SEARs related to the assessment of key issues.

For each key issue the existing environment is described, the potential impacts (both direct and indirect) of the project during construction and operation are assessed, the influence of relevant planning matters are considered, and proposed management measures are described. The proposed management measures in this chapter are summarised in **Chapter 9**.

The assessment of key issues is supported by detailed investigations, are been documented in the technical assessment reports in **Appendix E** to **Appendix P**.

Table 7-1 SEARs (Assessment of key issues)

Secretary's requirements	Where addressed
3. Assessment of key issues	
1. The level of assessment of likely impacts must be proportionate to the significance of, or degree of impact on, the issue, within the context of the proposal location and the surrounding environment. The level of assessment must be commensurate to the degree of impact and sufficient to ensure that the Department and other government agencies are able to understand and assess impacts.	Assessment of impacts proportionate to significance of impacts is presented throughout **Chapter 7** and **Chapter 8**
2. For each key issue the Proponent must: a. describe the biophysical and socio-economic environment, as far as it is relevant to that issue;	Relevant biophysical and socio-economic environments are described in **Chapter 7** and **Chapter 8**
b. describe the legislative and policy context, as far as it is relevant to the issue;	Legislative and policy context is described in **Chapter 2** and throughout **Chapter 7** and **Chapter 8**
c. identify, describe and quantify (if possible) the impacts associated with the issue, including the likelihood and consequence (including worst case scenario) of the impact (comprehensive risk assessment), and the cumulative impacts;	Impacts (including cumulative impacts) are described in **Chapter 7** and **Chapter 8** An environmental risk analysis is presented in **Chapter 10**
d. demonstrate how options within the project potentially affect the impacts relevant to the issue;	Alternatives and options relating to relevant impacts are presented in **Chapter 4**, with assessment of relevant impacts further discussed in **Chapter 7** and **Chapter 8**
e. demonstrate how potential impacts were avoided (through design, or construction or operation methodologies);	Avoidance of impacts through methodologies is presented throughout **Chapter 7** and **Chapter 8**
f. detail how likely impacts that have not been avoided through design will be minimised, and the predicted effectiveness of these measures (against performance criteria where relevant); and	Minimisation of impacts is presented throughout **Chapter 7** and **Chapter 8** and summarised in **Chapter 9** Residual risks are assessed in **Chapter 10**

Secretary's requirements	Where addressed
g. detail how any residual impacts will be managed or offset, and the approach and effectiveness of these measures.	Minimisation of impacts is presented throughout **Chapter 7** and **Chapter 8** and summarised in **Chapter 9** Residual risks are assessed in **Chapter 10**
3. Where multiple reasonable and feasible options to avoid or minimise impacts are available, they must be identified and considered and the proposed measure justified taking into account the public interest.	Options to avoid or minimise impacts are identified and considered throughout **Chapter 7** and **Chapter 8**

Assessment of cumulative impacts

The SEARs relevant to the assessment of cumulative impacts are presented in **Table 7-2**.

Table 7-2 SEARs (Cumulative impacts)

Secretary's requirement	Where addressed in this EIS
2. Environmental Impact Statement	
Cumulative impact assessment n. an assessment of the cumulative impacts of the project taking into account other projects that were approved but where construction has not begun, projects that have begun construction, and projects that have recently been completed	Cumulative impacts are assessed in **Section 7.1** to **Section 8.6** The assessment approach is outlined in this section

Assessment approach

Cumulative impacts are compounding environmental and community impacts caused by past, present or reasonably foreseeable future activities. Cumulative impacts may arise from the interaction of construction and operation activities of the project and other approved or proposed projects in the area. When considered in isolation, specific project impacts may be considered minor. However, these minor impacts may be more substantial when the impact of multiple projects on the same receivers is considered.

Impacts can be either adverse or beneficial. Where an adverse impact is considered likely, mitigation and/or management measures would be implemented to avoid or reduce those impacts. This section assumes that the specific mitigation and management measures outlined for the project in the various sections of this EIS were applied and therefore focuses on the more strategic measures that may be implemented in coordination with other relevant projects. Project benefits are discussed in **Chapter 3**.

The following websites were searched for recent or proposed projects that could interact with the project:

- The former Department of Planning and Environment website (currently DPIE)
- The Roads and Maritime website
- Penrith City Council
- Fairfield City Council
- Liverpool City Council
- TfNSW.

Identification of projects for consideration was based on the following criteria:

- Project size – major projects or known development planned in the study area were considered
- Project location – includes projects or developments planned near the project, including link and feeder roads within about 10 kilometres of the project
- Project timeframe – relevant projects likely to be carried out at some point during the construction period of, and would interact with, the project.

Based on these considerations, projects that may contribute to cumulative impacts along with the project are listed in **Table 7-3** and shown in **Figure 7-1**. Cumulative impacts arise through spatial proximity (ie how close one project might be to another) as well as temporal proximity (ie projects that occur in a similar timeframe or have overlapping schedules). The table identifies the relevance of each project to the M12 Motorway project in terms of spatial and temporal considerations.

In addition to the projects listed in the table, the traffic and transport assessment included the following potential projects in the network scenarios underpinning the traffic models for 2024, 2026 and 2036:

- Bringelly Road upgrade
- Cowpasture Road upgrade – M7 Motorway to Camden Valley Way
- Fifteenth Avenue upgrade – Cowpasture Road to Fourth Avenue
- M7 Motorway widening
- Luddenham Road/Adams Road intersection upgrade.

The modelling and network scenarios are detailed in **Section 7.2.2**.

Depending on the environmental issue, the type of assessment carried out in this EIS is quantitative (such as predictive through modelling), qualitative, or a combination of both. The projects included in the cumulative impact assessment were evaluated by technical specialists for the relevant key issues as identified in **Table 7-3**.

Table 7-3 Projects considered as part of the cumulative impact assessment

Project and status	Relevance to the project	Description
Western Sydney Airport Approved. Under construction	Project is expected to have concurrent/ consecutive construction and operation Project is adjacent and has overlapping footprints	The Australian Government is currently constructing the Western Sydney Airport on the 1780-hectare Commonwealth-owned land at Badgerys Creek. The airport will service both domestic and international markets and development will be staged in response to ongoing growth in aviation demand. Stage 1 includes the establishment of the following to provide operational capacity for about 10 million passengers per year and freight traffic: • A single 3700 metre runway in the north–western portion of the site • A terminal • Other support facilities • Foundation for further expansion. It is anticipated that the demand in relation to this airport will reach about 82 million passengers a year by 2063. To cater for this, a second parallel runway will be constructed at a later stage. Construction of the Western Sydney Airport is under way and the airport is set to open in 2026. Construction of the project is expected to begin in the first quarter of 2022 and conclude in 2025.

Project and status	Relevance to the project	Description
Sydney Metro Greater West Not yet approved	Project is expected to have concurrent construction and operation Project is adjacent and has overlapping footprints	The Sydney Metro Greater West would connect the existing Main South Line (T8) near Macarthur Station to the existing Main Western Line (T1) near St Marys Station, via the Western Sydney Airport. The Sydney Metro Greater West project would have: • Stations at the Western Sydney Airport and the Western Sydney Aerotropolis • A station at St Marys, interchanging with the existing station and connecting customers with the rest of Sydney's rail system • Fully-automated driverless trains with fast, frequent services. Planning for this project is currently underway and subject to separate environmental assessment and approval. As such, environmental assessment results are not yet available. The Sydney Metro Greater West is expected to be operational in 2026 when the Western Sydney Airport is scheduled to open.
The Northern Road upgrade Approved. Construction has begun	Project is expected to have concurrent construction and operation Project is adjacent and has overlapping footprints	An upgrade of The Northern Road was approved in May 2018 as part of the WSIP. The upgrade will improve the capacity of the existing road and create about eight kilometres of new road between Mersey Road, Bringelly and just south of the existing Elizabeth Drive, Luddenham to realign the section of The Northern Road that currently runs through the Western Sydney Airport site. Once the upgrade is complete, The Northern Road will connect the project and the M4 Western Motorway, and improve connectivity with the Western Sydney Airport (Roads and Maritime, 2017a). The upgrade is being carried out in six stages. Stages 1 through 4 of The Northern Road upgrade will be completed by the time construction of the project begins. The construction for Stage 5 (between Littlefields Road, Luddenham and Glenmore Parkway, Glenmore Park) is scheduled for early 2019 to end of 2022. The construction for Stage 6 (between Eaton Road and Littlefields Road, Luddenham) is scheduled for mid-2019 to end of 2021. Construction activities associated with Stage 5 and 6 may overlap with the project construction.
Other existing road network upgrades and potential road projects, including: • Elizabeth Drive upgrade • Mamre Road upgrade • Outer Sydney Orbital Not yet approved	Projects have the potential for overlapping construction Projects are expected to have concurrent operation Project is adjacent and has overlapping footprints	There are a number of other planned and potential road upgrade projects in the western Sydney area that may contribute to cumulative impacts. These potential projects include: • Elizabeth Drive upgrade – Roads and Maritime has started site investigations, including preliminary engineering, preliminary/strategic designs, environmental field investigations, and strategic modelling. These investigations are expected to be completed by mid-2019 • Mamre Road upgrade – the NSW Government has started early planning for a future upgrade of a 10-kilometre section of Mamre Road, between the M4 Motorway and Kerrs Road to support economic and residential growth in the area • Outer Sydney Orbital – a future north–south motorway and freight rail line in Sydney's West to support the growth of western Sydney and the distribution of freight across Sydney and regional NSW (TfNSW, 2018). While the Outer Sydney Orbital is in early stages of planning, it would provide connections to the Western Sydney Airport. These projects are currently at varying stages of planning and no design or environmental assessment information is currently publicly available.

Project and status	Relevance to the project	Description
Major land releases including: • Western Sydney Aerotropolis • South West Growth Area • Western Sydney Employment Area Future strategic government project	Projects have the potential for overlapping construction Projects are expected to have concurrent operation The Aerotropolis and the Western Sydney Growth Area have overlapping footprints The Sydney Employment Area is in the vicinity of the project	Western Sydney is the focus of a number of plans and policies to promote changes in land use and to increase employment opportunities, including the following defined areas (see **Figure 7-1**): • Western Sydney Aerotropolis – The area surrounding the Western Sydney Airport that was previously known as the Western Sydney Airport Growth Area. The Aerotropolis would establish a new high-skill jobs hub across aerospace and defence, manufacturing, healthcare, freight and logistics, agribusiness, education and research industries, and is expected to contribute to establishing 200,000 new jobs for Western Sydney (DPE, 2018a). • South West Growth Area – The broader area south-east of the Western Sydney Aerotropolis. This will guide new infrastructure investment, identify new homes and jobs close to transport, and coordinate services in the area. The NSW Government is currently at the early stages of investigations. • Western Sydney Employment Area – The area north-east of the Western Sydney Growth Area. Established by the NSW Government to be a new employment space, providing opportunities for local people to work closer to home. Preliminary investigations and community consultation are underway for each area. The land within the areas above will be developed by individual developers at varying timeframes. Each will be subject to their own environmental assessments, based on the scale and potential impact of each project. There are currently no defined plans available for the individual developments within these growth areas. The project would traverse the Western Sydney Priority Growth Area and service the Western Sydney Aerotropolis, and indirectly, the Western Sydney Employment Area. The timing for the construction of developments within the above-mentioned growth areas has not yet been announced.

Potential cumulative impacts considered

This assessment of cumulative impacts was based on the most current and publicly available information on the project listed above. In some cases, projects are in the early stages of strategy development or design and an EIS has not been prepared. In these cases, reasonable assumptions were made in assessing potential cumulative impacts and these will need to be confirmed during the assessments for these projects or developments, which would be based on information available at that time.

A consequence of concurrent or consecutive activities occurring over extended periods of time is the concept of construction fatigue. Construction fatigue can be experienced by receivers that are in the vicinity (spatially proximate) of concurrent or consecutive project construction activities where the activities overlap or have little or no break between the activities of one project, or multiple adjacent projects. Where construction timeframes for projects occur sequentially, there is potential for disturbance and disruptions for local communities (eg construction noise, dust, traffic delays and disruptions) to occur over extended periods, potentially resulting in construction fatigue for some community members.

Ancillary activities refer to works by utility and service providers to provide new or relocated utilities (such as electricity, telecommunications, water and sewage connections). These activities were considered and assessed in the EIS (see **Section 5.20** for further details). They do not form part of the cumulative impact assessment. These works may also lead to local traffic disruptions, restrictions to access, noise and vibration impacts, potential dust generation and reduced visual amenity.

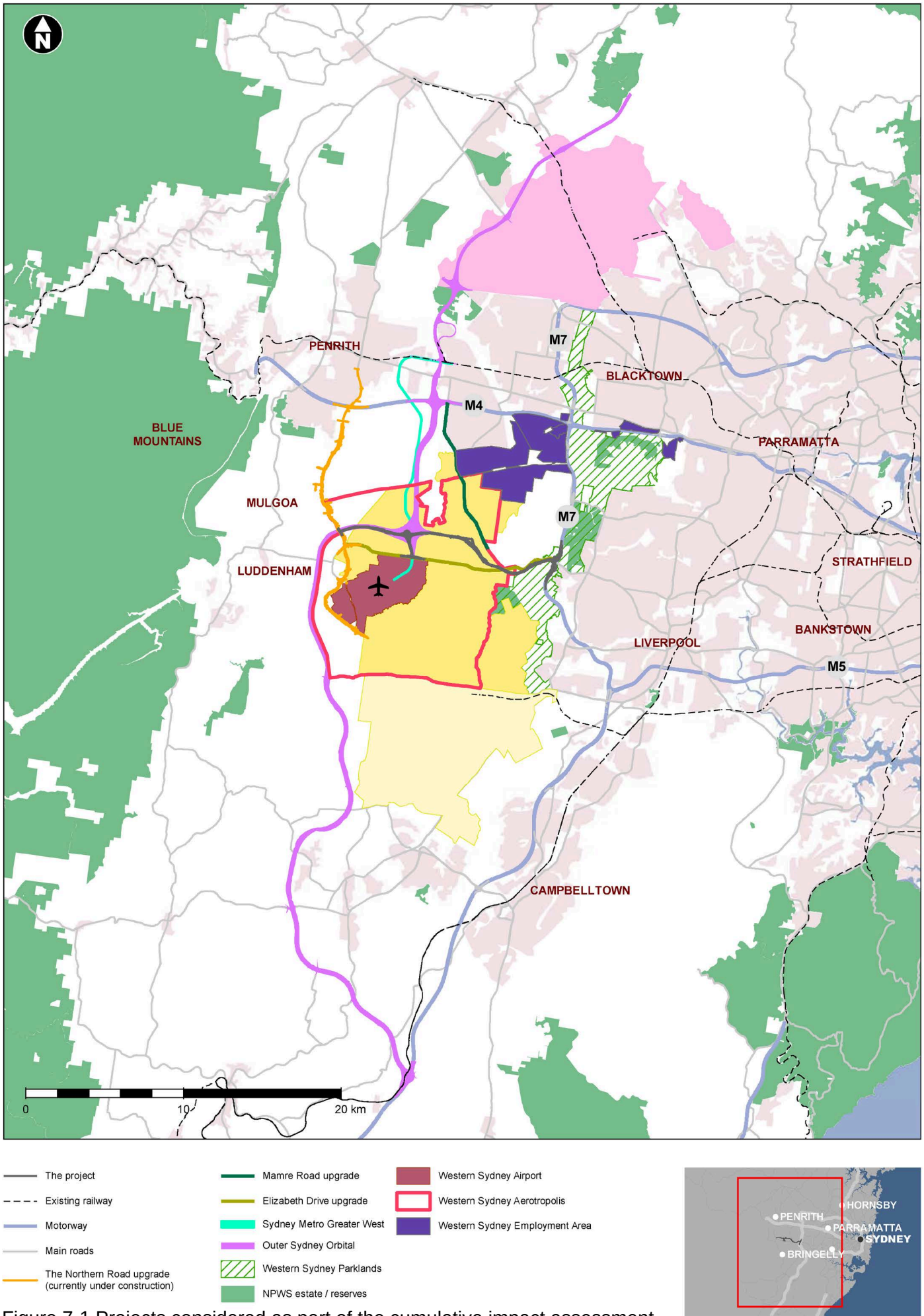


Figure 7-1 Projects considered as part of the cumulative impact assessment

7.1 Biodiversity

This section describes the potential biodiversity impacts associated with construction and operation of the project and how impacts would be managed. **Table 7-4** outlines the SEARs that relate to biodiversity and identifies where they are addressed in this EIS. The Commonwealth assessment requirements are presented in **Table 7-5**.

The full assessment of biodiversity impacts is provided in **Appendix E**. A Biodiversity Offset Strategy (BOS) was also prepared, under the Framework for Biodiversity Assessment (FBA) (OEH, 2014), to identify residual biodiversity impacts and detail how required offset credits are to be retired (Annexure D of **Appendix E**).

Table 7-4 SEARs for the project (biodiversity)

Secretary's requirement	Where addressed in this EIS
5. Biodiversity	
1. The Proponent must assess biodiversity impacts in accordance with the current guidelines including the Framework for Biodiversity Assessment (FBA).	Planning and policy and the requirements of the FBA is discussed in **Section 7.1.1** The assessment methodology that was developed in accordance with current guidelines including the FBA is discussed in **Section 7.1.2** The findings of the assessment are provided in **Section 7.1.4**
2. The proponent must assess any impacts on biodiversity values not covered by the FBA as specified in s2.3. OEH would provide specific assessment requirements for any such impacts during agency consultation on the SEARs.	**Section 7.1.4** provides an assessment of values not covered by the FBA
3. The Proponent must assess impacts on the following (EECs, threatened species and/or populations) and provide the information specified in s9.2 of the FBA.	The assessment methodology is discussed in **Section 7.1.2** **Section 7.1.4** provides the assessment findings including an assessment of impacts on EECs, threatened species and/or populations in accordance with section 9.2 of the FBA. Further details provided in **Appendix E**
4. The Proponent must identify whether the project as a whole, or any component of the project, would be classified as a Key Threatening Process (KTP) in accordance with the listings in the *Threatened Species Conservation Act 1997* (NSW) (TSC Act), *Fisheries Management Act 1994* (FM Act) and *Environment Protection and Biodiversity Conservation Act 2000* (EPBC Act).	Potential impacts of KTPs are discussed in **Section 7.1.4** and Annexure G of **Appendix E**
16. Protected and sensitive lands	
1. The Proponent must assess the impacts of the project on environmentally sensitive land and processes (and the impact of processes on the project) including, but not limited to: a) Key Fish Habitat as mapped and defined in accordance with the *Fisheries Management Act 1994* (FM Act);	Temporary and permanent impacts on key fish habitat and fish passage are discussed and assessed in **Section 7.1.4** Key fish habitat has also been considered in the identification of sensitive receiving environments (SREs) as detailed in **Section 7.9.2**

Secretary's requirement	Where addressed in this EIS
b. waterfront land as defined in the *Water Management Act 2000*;	Impacts on waterfront land are discussed in **Sections 7.9.4** and **7.9.6** Impacts on riparian corridors are discussed further in **Section 7.1.4**
c. land or waters identified as Critical Habitat under the TSC Act, FM Act or EPBC Act; and	Impacts on Critical Habitat are assessed under matters for further consideration in **Section 7.1.4**
d. biobank sites, private conservation lands and other lands identified as offsets.	A description of the relevant biobanking site is provided in **Section 7.1.3** (Biobanking site) and impacts on the site are assessed in **Section 7.1.4** (Impacts on Biobanking site)

Table 7-5 SEARs Attachment A: Guidelines for preparing Assessment Documentation relevant to the EPBC Act (biodiversity)

Secretary's Requirement	Where addressed in this EIS
1. On 19 October 2018 it was determined that the M12 Motorway Project will impact upon the following matters of national environmental significance (MNES) protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act): • Threatened species and communities The project will be assessed in accordance with the NSW Assessment Bilateral Agreement 2015 (the Agreement) and as such is required to be assessed in the manner specified in Schedule 1 to that Agreement. These requirements are a supplement to the Secretary's Environmental Assessment Requirements issued on 12 July 2018 and should be addressed in conjunction with those requirements.	The project's potential impacts on MNES are assessed in **Section 7.1.4**
2. Assessment documentation prepared for the purposes of approval under the EPBC Act must, in addition to providing sufficient information for a decision in accordance with the Agreement, address the matters outlined in Schedule 4 of the Environment Protection and Biodiversity Conservation Regulations 2000 (Commonwealth). Proponents are advised to check that requirements in Schedule 4 of the EPBC Regulations were appropriately addressed.	The requirements of the EPBC Regulations and the EPBC Act in terms of assessment methodology, description of the action and assessment of impacts are addressed in **Section 7.1.2**, **Section 7.1.3**, and **Section 7.1.4**
3. The requirements are intended such that there is sufficient information in the assessment report relevant to MNES such that the Commonwealth decision-maker may make a determination on whether or not to approve the action. The proponent must undertake an assessment of all the protected matters that may be impacted by the development under the controlling provision identified in paragraph 1. A list of protected matters that are considered likely to be significantly impacted is provided at Attachment A to these Guidelines. Note that this may not be a complete list and it is the responsibility of the proponent to ensure	Impact assessment methodology, including development and execution of field surveys, is addressed in **Section 7.1.2** The existing environment, including presence of species and ecosystems relevant to MNES, is described in **Section 7.1.3** Impacts on MNES are assessed in accordance with the EPBC Regulations in **Section 7.1.4**

Secretary's Requirement	Where addressed in this EIS
any protected matters under this controlling provision, likely to be significantly impacted, are assessed for the Commonwealth decision-maker's consideration.	
General requirements Project description	
4. The title of the action, background to the development and current status.	The title of the action is provided in **Chapter 1** Background to the project, its development and current status are provided in **Chapter 1, Section 2.1,Chapter 3** and **Chapter 4**
5. The precise location and description of all works to be undertaken (including associated offsite works and infrastructure), structures to be built or elements of the action that may have impacts on matters of national environmental significance (MNES).	The project scope and key design elements are discussed in **Section 5.1** through to **Section 5.23** The construction of the project is discussed in **Section 5.24**
6. How the action relates to any other actions that were, or are being taken, in the region affected by the action.	Cumulative impacts on biodiversity and MNES are described and assessed in **Section 7.1.5**
7. How the works are to be undertaken and design parameters for those aspects of the structures or elements of the action that may have relevant impacts on MNES.	Design parameters for structures and elements that may impact on MNES (threatened species) are discussed in **Section 5.2** How the works are proposed to be carried out is discussed in **Section 5.24** Discussion of how some elements of the project may have impacts on MNES (threatened species) is provided in **Section 7.1**
Impacts	
8. The EIS must include an assessment of the relevant impacts of the action on threatened species and communities; including • a description and detailed assessment of the nature and extent of the likely direct, indirect and consequential impacts, including short term and long-term relevant impacts;	Potential impacts are described in **Section 7.1.4**
• a statement whether any relevant impacts are likely to be known, unpredictable or irreversible; analysis of the significance of the relevant impacts;	See **Section 7.1.4** and Annexure G of **Appendix E**
• any technical data and other information used or needed to make a detailed assessment of the relevant impacts; and	Discussion of technical data and information used to inform the assessment is provided **Section 7.1.2**
• a comparative description of the impacts of alternatives, if any, on the threatened species and communities.	A high level comparative description of impacts of alternatives are provided in **Chapter 4** More detail of impacts on threatened species and communities is provided in **Section 7.1.4**

Secretary's Requirement	Where addressed in this EIS
Avoidance, mitigation and offsetting	
9. For each of the relevant matters protected that are likely to be significantly impacted by the development, the EIS must provide information on proposed avoidance and mitigation measures to deal with the relevant impacts of the action, including: • a description and an assessment of the expected or predicted effectiveness of the mitigation measures;	Propose mitigation measures are discussed in **Chapter 9** of the EIS and Chapter 10 of **Appendix E** Expected effectiveness of proposed measures is provided in **Appendix A** and **Appendix E**
• any statutory policy basis for the mitigation measures;	Statutory policy as the driver requiring mitigation is discussed in **Section 7.1.4** **Section 7.1.6** provides discussion on the statutory policy requirements that would be met by the proposed mitigation measures
• the cost of the mitigation measures;	Costs associated with offsets are discussed in **Section 7.1.7** Costs associated with other mitigation measure are not known at this stage and not included
• a description of the outcomes that the avoidance and mitigation measures will achieve;	**Section 7.1.4** **Section 7.1.6** **Chapter 10**
• an outline of an environmental management plan that sets out the framework for continuing management, mitigation and monitoring programs for the relevant impacts of the action;	An outline CFFMP is provided in B01 in **Section 7.1.6** and in **Section 9.3**
• the name of any agency responsible for endorsing or approving a mitigation measure or monitoring program;	Responsibility and endorsement and approval where relevant for proposed mitigation measures is discussed in **Section 7.1.6**
• a description of the offsets proposed to address the residual adverse significant impacts and how these offsets will be established.	Proposed offsets are discussed in **Section 7.1.7** and an Offset Strategy is provided in **Appendix E**
10. Where a significant residual adverse impact on a threatened species or community is considered likely, the EIS must provide information on the proposed offset strategy, including discussion of the conservation benefit associated with the proposed offset strategy. Paragraphs 13 & 14 provide further requirements in relation to offsets.	**Section 7.1.7** provides discussion of the proposed offsets, with further details provided in the offset strategy in Annexure D of **Appendix E**
Key issues - biodiversity	
11. The EIS must address the following issues in relation to biodiversity including separate: • identification of each EPBC Act listed threatened species and community likely to be impacted by the development. Provide evidence why other EPBC Act listed threatened species and communities likely to be located in the project area or in the vicinity will not be impacted.	Identification of species likely to be present in the study area is provided in **Section 7.1.3** and discussion of potential impacts provided **Section 7.1.4** including discussion of species and communities not expected to be impacted

Secretary's Requirement	Where addressed in this EIS
12. For each of the relevant EPBC Act listed threatened species and communities likely to be impacted by the development the EIS must provide a separate: • description of the habitat and habits (including identification and mapping of suitable breeding habitat, suitable foraging habitat, important populations and habitat critical for survival), with consideration of, and reference to, any relevant Commonwealth guidelines and policy statements including listing advice, conservation advice and recovery plans, threat abatement plans and wildlife conservation plans; and	This description is provided in **Section 7.1.3** with further details in Annexure B of **Appendix E**
• details of the scope, timing and methodology for studies or surveys used and how they are consistent with (or justification for divergence from) published Australian Government guidelines and policy statements.	Scope, timing and methodology of surveys is discussed in **Section 7.1.2** Further details in **Appendix E**
• description of the impacts of the action having regard to the full national extent of the species or community's range.	**Section 7.1.4** Further details in **Appendix E**
13. For each of the relevant EPBC Act listed threatened species and communities likely to be significantly impacted by the development the EIS must provide a separate: • identification of significant residual adverse impacts likely to occur after the proposed activities to avoid and mitigate all impacts are taken into account.	**Section 7.1.4** **Section 7.1.7** **Chapter 10** Further details in Annexure D of **Appendix E**
• details of how the current published NSW Framework for Biodiversity Assessment (FBA) was applied in accordance with the objects of the EPBC Act to offset significant residual adverse impacts;	**Section 7.1.2** **Section 7.1.7** Further details in Annexure D of **Appendix E**
• details of the offset package to compensate for significant residual impacts including details of the credit profiles required to offset the development in accordance with the FBA and/or mapping and descriptions of the extent and condition of the relevant habitat and/or threatened communities occurring on proposed offset sites.	**Section 7.1.7** Further details in Annexure D of **Appendix E**
Note: For the purposes of approval under the EPBC Act, it is a requirement that offsets directly contribute to the ongoing viability of the specific protected matter impacted by a proposed action ie 'like for like'. In applying the FBA, residual impacts on EPBC Act listed threatened ecological communities must be offset with Plant Community Type(s) (PCT) that are ascribed to the specific EPBC listed ecological community. PCTs from a different vegetation class will not generally be acceptable as offsets for EPBC listed communities.	**Section 7.1.7** Further details in Annexure D of **Appendix E**

Secretary's Requirement	Where addressed in this EIS
14. Any significant residual impacts not addressed by the FBA may need to be addressed in accordance with the *Environment Protection and Biodiversity Conservation Act 1999* Environmental Offset Policy. [Note if the EPBC Act Environmental Offset Policy is used to calculate proposed offsets for a threatened species or community you may wish to seek further advice from the Department of Planning and Environment.]	**Section 7.1.7** Residual impacts are discussed further in Annexure D of **Appendix E**
15. For each threatened species and community likely to be significantly impacted by the development, the EIS must provide reference to, and consideration of, relevant approved conservation advice or recovery plan for the species or community.	**Section 7.1.2** **Section 7.1.7** Conservation advice and recovery plans were considered further in **Appendix E**
Environmental Record of person proposing to take the action	
16. Information in relation to the environmental record of a person proposing to take action must include details as prescribed in Schedule 4 Clause 6 of the EPBC Regulations 2000.	**Appendix Q**
Information sources	
For information given in the EIS, the EIS must state the source of the information, how recent the information is, how the reliability of the information was tested; and what uncertainties (if any) are in the information.	Throughout this EIS document

7.1.1 Policy and planning setting

The BAR (**Appendix E**) was prepared to assess the impacts of the project in accordance with the following relevant legislation:

- Biodiversity Conservation (Savings and Transitional) Regulation 2017
- Threatened Species Conservation Act 1995 (TSC Act)
- NSW Biodiversity Offsets Policy for Major Projects (OEH, 2014b)
- Framework for Biodiversity Assessment (FBA) (OEH, 2014a)
- State Environment Planning Policy (Sydney Region Growth Centres) 2006 (Growth Centres SEPP) (TSC Act considerations) – described further below
- Water Management Act 2000
- Fisheries Management Act 1994 (FM Act)
- Policy and guidelines for fish habitat conservation and management (DPI, 2013)
- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
- NSW Bilateral Agreement made under section 45 of the EPBC Act relating to environmental assessment (2015)
- Environment Protection and Biodiversity Conservation Regulations 2000
- Strategic assessment – Sydney Growth Centres Program (EPBC Act considerations) – described further below.

Further detail on the relevant legislation is provided in Section 1.4 of **Appendix E**.

State Environment Planning Policy (Sydney Region Growth Centres) 2006

The State Environment Planning Policy (Sydney Region Growth Centres) 2006 (Growth Centres SEPP) aims to co-ordinate the release of land for urban development in the North West and South West growth centres of the Sydney region. A portion of the eastern section of the study area is located within the South West growth centre as identified in the Growth Centres SEPP.

On 11 December 2007, an order conferring biodiversity certification on the Sydney Growth Centres SEPP was made by the Minister for the Environment under section 126G of the TSC Act. Under the environmental assessment requirements for the approval of State significant infrastructure under Part 5.1 of the EP&A Act (now Division 5.2) do not require the assessment of the infrastructure on biodiversity values if the infrastructure is carried out on 'certified' land. Therefore, further impact assessment for matters listed under the TSC Act would not be required for areas designated as ‘certified’. Development within “non-certified” land contained within the South West Growth Centre area, requires assessment under normal legislative requirements, having regard to the terms of the Biodiversity Certification order.

Biodiversity certification does not include the following land within the Growth Centres area:

- Lands identified in the SEPP as environment conservation or public recreation zonings
- Lands identified as offsets to the Western Sydney Orbital (Colebee, Kemps Creek and Rouse Hill)
- Lands zoned for regional park or environmentally significant land overlay at Edmondson Park
- Lands within the Western Sydney Parklands.

The portion of the study area (defined in **Section 7.1.2**) that is located within the Growth Centres SEPP is mapped within the certified area on the map accompanying the Biodiversity Certification Order. This is discussed further in **Section 7.1.3**.

Strategic assessment – Sydney Growth Centres Program (EPBC Act considerations)

The NSW DPIE (Planning and Assessment) in consultation with the DoEE, undertook a strategic assessment under the EPBC Act of the Sydney Growth Centres Program (the Program) (DoP, 2010). The Commonwealth Minister endorsed the Program document in December 2011, and consequently approved all actions associated with the development of the Western Sydney Growth Centres.

The Program builds upon the Biodiversity Certification for the Growth Centres SEPP conferred in 2007 under the TSC Act and specifies a range of additional measures that specifically target MNES listed under the EPBC Act. In particular, the program requires the NSW Government to ensure that:

- A minimum of 998 hectares of Cumberland Plain Shale Woodlands and Shale Gravel Transition Forest (CPW) will be retained and protected within the Growth Centres, including a minimum of 363 hectares of high management viability (HMV) CPW
- At least 2400 hectares of either CPW, or other grassy woodland communities which are similar to CPW in floristic structure, will be protected outside of the Growth Centres. As part of this commitment at least 205 hectares of additional HMV CPW will be protected outside of the Growth Centre.

HMV vegetation is defined in the Growth Centres Draft Conservation Plan (Eco Logical Australia, 2007) as areas that are endangered ecological community (EEC), in good condition based on existing regional mapping, greater than four hectares in size, with good landscape connectivity and less likely to be impacted by surrounding land use threats.

The Strategic Assessment relies on the information in the Growth Centres Draft Conservation Plan to evaluate the impacts on native vegetation in the Growth Centres. The Strategic Assessment endorses the offset mechanisms in the Biodiversity Certification Order, provided that they deliver the program commitments.

Given that there is no native vegetation within the non-certified area in the construction footprint subject to the specific offsetting requirements listed in the Biodiversity Certification Order, there are also no specific offset requirements for the project under the Strategic Assessment.

Relevant guidelines

The BAR (**Appendix E**) was prepared to assess the impacts of the project on biodiversity values in accordance with the requirements of the NSW Biodiversity Offsets Scheme and the FBA. The FBA applies mostly to terrestrial impacts. The assessment of impacts of the project on aquatic environments and biodiversity was carried out in accordance with the Policy and Guidelines for Fish Habitat Conservation and Management (update 2013) which incorporates Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003).

The BAR has also considered the following guidelines:

- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities working draft (DEC, 2004)
- Threatened Species Assessment Guidelines: the assessment of significance (DECC, 2007a)
- Significant Impact Guidelines 1.1 Matters of National Environmental Significance (Department of Sustainability Environment Water Population and Communities, 2013)
- NSW Guide to Surveying Threatened Plants (OEH, 2016a)
- Environmental Impact Assessment Guidelines for the Green and Golden Bell Frog (*Litoria aurea*) (NSW NPWS, 2003)
- BioBanking Assessment Methodology (BBAM) (OEH, 2014c)
- Survey guidelines for Australia's threatened mammals: Guidelines for detecting mammals listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (CoA, 2011)
- Guidelines for developments adjoining land and water managed by the Department of Environment, Climate Change and Water (DECCW, 2010b)
- Guidelines for controlled activities on waterfront land (DPI, 2012a)
- Guidelines for developments adjoining land managed by the Office of Environment and Heritage (OEH, 2013a).

7.1.2 Assessment methodology

The key components of the BAR included:

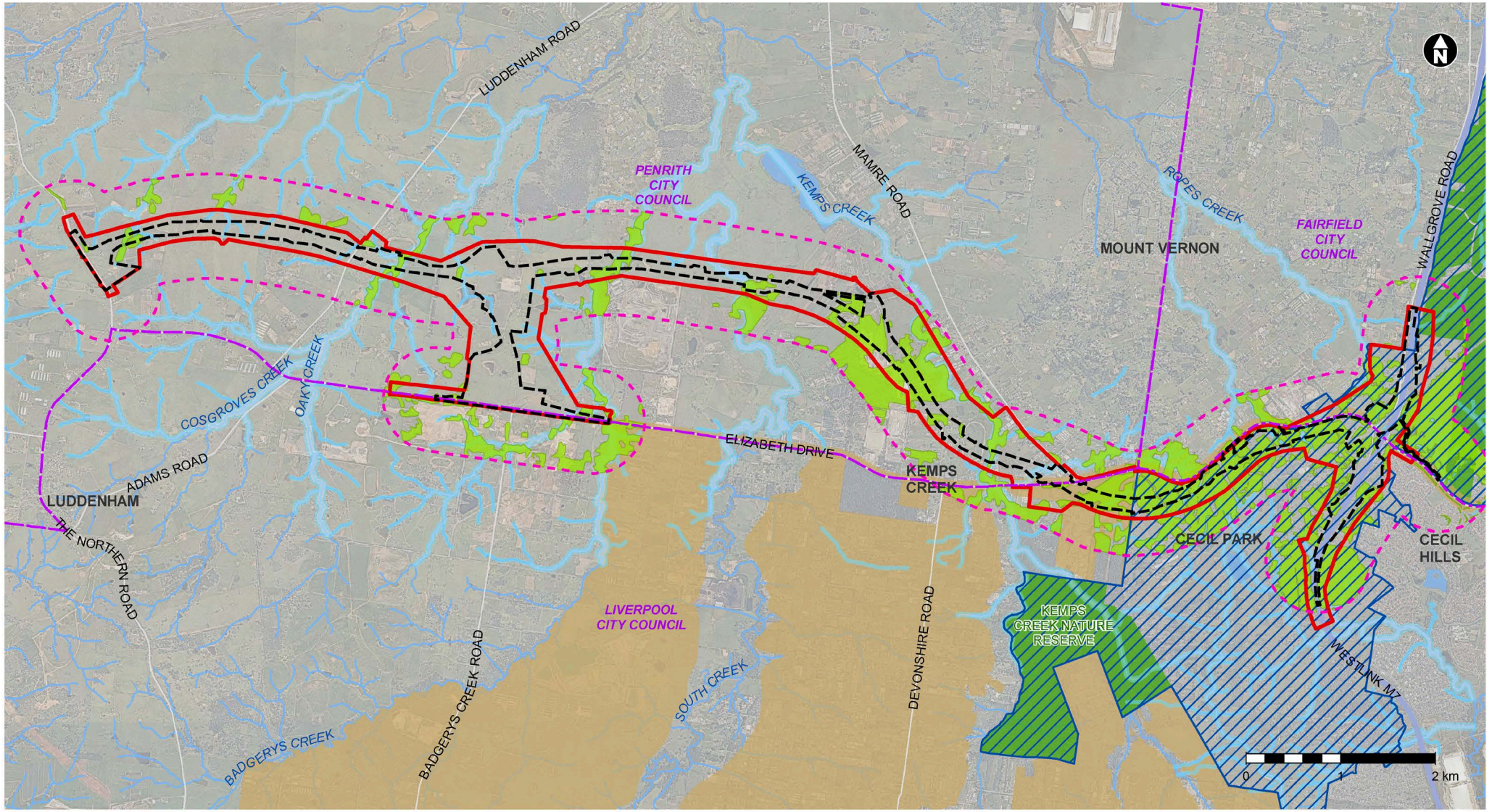
- Desktop review of:
  - NSW BioNet Species Sightings data collection, managed by the Environment, Energy and Science Group (EESG) of DPIE
  - Protected Matters Search Tool, managed by the Commonwealth Department of the Environment and Energy (DoEE, 2018a)
  - BioNet Vegetation Classification data collection managed by EESG of DPIE
  - BioNet Threatened Species data collection, managed by EESG of DPIE
  - NSW WeedWise, managed by DPI
  - RIAR Spatial Data Portal
  - Other relevant environmental and strategic planning documents
- Undertaking a likelihood of occurrence assessment involving determining the likelihood of a particular species occurring within the study area. A likelihood ranking was assigned to species, including 'recorded', 'high', 'moderate', 'low' and 'none'. The likelihood of occurrence assessment was used to guide and inform the field surveys carried out for the project.
- Field surveys to identify the biodiversity values within the study area in accordance with requirements of the FBA, including:
  - Vegetation surveys over 13 days between May and November 2017, August and September 2018 and in February 2019
  - Targeted flora surveys over 16 days during October, November 2017 and August 2018
  - Terrestrial fauna habitat assessments at 43 sites across the study area
  - Targeted fauna surveys for species with a moderate to high likelihood of occurrence carried out over 34 days between May 2017 and October 2018
  - Aquatic habitat assessments carried out on 18 and 19 June 2018 and 11 March 2019 at 14 waterway locations across the study area
- Identification and assessment of likely impacts on biodiversity arising from the project
- Mitigation measures for avoiding, managing or reducing impacts on biodiversity values during detailed design, construction and operation
- Identification of any residual impacts that cannot be avoided, minimised or mitigated which must be offset.

Further detail about the assessment methodology, including field surveys undertaken is provided in **Appendix E**.

Study area

The study area for field survey purposes is shown in **Figure 7-2**. The study area used for database searches and desktop landscape assessment is broader than this and included an area up to about 10 kilometres from the project. This broader study area is used for the purposes of reviewing regional vegetation mapping and searches for previously recorded threatened species.

In accordance with the FBA, native vegetation cover per centages were calculated as a proportion of all land within the 550 metre landscape buffer (see **Figure 7-2**) from the centre line of the construction footprint that contains native vegetation.



*Entire map extent is covered by the IBRA 7 Region - Sydney Basin,and IBRA 7 Subregion - Cumberland. No SEPP 14 Coastal Wetlands or Ramsar Wetlands are present in the entire map extent.

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Figure 7-2 Biodiversity assessment study area

Under the FBA (OEH, 2014a), the area subject to impact assessment is referred to as the 'development site'. For the purposes of the BAR and overall environmental assessment, the 'development site' is considered to encompass the construction footprint. The development site is referred to as the 'construction footprint' in this section. It should be noted that the boundary of the construction footprint shifted slightly during the assessment period, resulting in a study area defined in this report that does not encompass the entire construction footprint. However, while some sections of the construction footprint are shown as extending outside the study area, these sections were considered within the impact assessment.

Sensitive receiving environment

The sensitivity of an environment can affect the significance of project impacts. The more sensitive the environment, the more likely an action is to have a significant impact. Sensitive receiving environments (ie waterbodies) for the project were identified based on proximity to the following:

- Key fish habitat field assessment in accordance with DPI (2013)
- Key Fish Habitat Mapping (DPI, 2018)
- Waterway classification (Fairfull and Witheridge, 2003)
- Threatened aquatic species listed under the FM Act and/or EPBC Act
- Groundwater and surface water dependent vegetation and fauna communities listed under the BC Act and EPBC Act
- Drinking water catchment
- Areas that contribute to aquaculture and commercial fishing
- Proximity to matters listed in the State Environmental Planning Policy (Coastal Management) 2018 (Coastal Management SEPP).

Key fish habitat

DPI (2013) outlines the habitat types and sensitivity classes used for assessing potential impacts of certain activities and developments on key fish habitat types. These are:

- Type 1 – Highly sensitive key fish habitat
- Type 2 – Moderately sensitive key fish habitat
- Type 3 – Minimally sensitive key fish habitat
- Not fish habitat.

The above habitat types are discussed in further detail in Section 2.3.4 of **Appendix E**.

These descriptions formed the basis for classifying the key fish habitats that were mapped as occurring within the study area.

In addition to the habitat type, the waterway class is also used to assess the functionality and determine the requirement to maintain long-term fish passage. The criteria by which the waterway class is derived is outlined in Section 2.3.4 of **Appendix E**.

Offsetting required

Under the FBA (OEH, 2014a), residual impacts that cannot be avoided, minimised or mitigated, must be offset. An accredited assessor uses the Biobanking Calculator to determine the ecosystem and/or species credits required to offset the loss in value for each credit type (OEH, 2018b).

Biobanking credits are split in to two broad categories: ecosystem credits and species credits. The number of credits required to offset a given impact is based on several factors, including:

- Ecosystem credits – the loss in site value and the area over which that loss will occur
- Species credits – the number of individuals or the area of habitat that would be removed.

Some species require both ecosystem credits and species credits. For example, particular habitat elements such as breeding habitat of cave-roosting bats may require species credits, whereas foraging habitat may be offset with ecosystem credits.

Under the DPI (2013) Policy and guidelines for fish habitat conservation and management impacts on KFH are to be offset by compensatory works to ensure no net loss. DPI (2013) calculates habitat compensation on a minimum 2:1 basis for all KFH lost; a greater compensation ratio may be considered if offsets cannot be sourced in the vicinity of the impact or are not of the same habitat type as that impacted.

Offsetting requirements under the FBA are discussed in **Section 7.1.7**.

In addition, impacts on areas of existing native vegetation (ENV) within certified areas are to be offset using funds from special infrastructure contributions that apply within the Growth Centres (under the Growth Centres SEPP), as determined during precinct planning. Offsets are therefore not required for the biodiversity impacts of the project within the certified areas. This is discussed further in 'Areas not requiring further assessment' in **Section 7.1.4**.

The Biodiversity Certification Order of the Growth Centres SEPP has specific requirements for offsetting any clearance of ENV on 'non-certified' land, however, the project is not impacting any ENV as defined under Schedule 1 of the Biodiversity Certification Order on the non-certified land.

7.1.3 Existing environment

Landscape features

The landscape features of the study area were determined in accordance with the requirements of the FBA. **Table 7-6** summarises the biodiversity landscape features of the study area.

Table 7-6 Biodiversity landscape features of the study area

Landscape feature	Description
Interim Biogeographic Rationalisation for Australia (IBRA) region and subregion	The study area is located within the Cumberland sub-region of the Sydney Basin IBRA Bioregion. The Cumberland sub-region is situated in a rain shadow area between the Blue Mountains and east coast on low rolling hills and valleys.
NSW Landscape Regions (Mitchell landscapes)	The majority of the study area is situated within the Cumberland Plain Mitchell Landscape with small portions of land located around the waterways listed as Hawkesbury – Nepean Channels and Floodplains landscape (NSW NPWS, 2002). Both are classified as over-cleared landscapes, with 89 per cent of the Cumberland Plain Mitchell Landscape currently cleared and 79 per cent of the Hawkesbury – Nepean Channels and Floodplains Mitchell Landscape currently cleared.
Soils	The majority of the study area occurs on three soil landscapes: Luddenham, Blacktown and South Creek. A small portion of the study area is mapped as Picton soil landscape, and another small patch is mapped as Disturbed Terrain. Further details on soils and geology are provided in **Section 8.1.3**.

Landscape feature	Description
Rivers and streams	The study area traverses a large part of the Lower Nepean River Management Zone of the Hawkesbury and Lower Nepean Rivers Water Source. The catchment covers much of the Cumberland Plain, generally flowing from south to north, towards the Hawkesbury River. The catchment is relatively flat with rolling shale hills. The study area intersects a number of waterways including Ropes Creek, Kemps Creek, South Creek, Badgerys Creek, Cosgroves Creek, Hinchinbrook Creek and their tributaries. Further details relating to stream orders are provided in **Table 7-17**.
Wetlands	Artificial wetlands (ie farm dams, detention basins, roadside drains, and effluent treatment systems) are scattered throughout the study area. A total of 28 dams occur within the study area. A wetland listed under the State Environmental Planning Policy (Coastal Management SEPP) 2018 and identified as a Coastal Wetland (ID 117) is located about 500 metres east of the Elizabeth Drive and M7 Motorway intersection, within Western Sydney Parklands. The unnamed tributary of Hinchinbrook Creek passes through the southern extent of the study area and flows into a Coastal Wetland (ID 276) about 1.8 kilometres to the southeast of the study area. Hinchinbrook Creek, about 330 metres south of the construction footprint, also flows into this Coastal Wetland. Doujon Lake and two other Coastal Wetlands (ID 113 and ID 114) lie near the study area on a tributary of Hinchinbrook Creek.
State or regionally significant biodiversity links	There are no State significant biodiversity links in the study area. Two areas mapped as 'Regional Corridors' in the EESG Biodiversity Investment Opportunities Map (BIOMAP) for the Cumberland IBRA subregion are located within the study area and have potential to be impacted. These are: • Woodland habitat along the eastern and western sides of the M7 Motorway • Riparian Forest and adjacent Woodland habitat associated with Kemps Creek, South Creek and Badgerys Creek. Four 4th order streams (Badgerys Creek, Kemps Creek, Cosgroves Creek and Hinchinbrook Creek), one 5th order stream (South Creek), and one 1st order stream (Ropes Creek) intersect the study area. The riparian buffers 20 metres either side of these streams meet the criteria for regionally significant biodiversity links as defined under the FBA.
Native vegetation cover	The current (before development) and future (after development) per centage of native vegetation cover was calculated in the BAR by measuring the current and future areas of regional vegetation mapping within the 550 metre landscape buffer as discussed above and shown in **Figure 7-2**. The current per cent native vegetation cover in the landscape buffer is 21 to 25 per cent, and the future per cent native vegetation cover in the landscape buffer is 16 to 20 per cent.
Connectivity value	In addition to the regionally significant biodiversity links mentioned above, areas within and adjoining the construction footprint are considered a 'local area biodiversity link'. This is categorised by vegetation in moderate to good condition that is greater than 250 hectares and wider than 30 metres. Habitat corridors are shown in **Figure 7-3**. The M7 Motorway and Elizabeth Drive already create significant barriers to habitat connectivity and impact regional habitat corridors in the study area.

Landscape feature	Description
Patch size	The largest patch of native vegetation intersecting the construction footprint comprises a network of mostly fragmented vegetation across the east of the construction footprint. This vegetation connects to the Kemps Creek Nature Reserve and areas further south in the Western Sydney Parklands. This patch is greater than 100 hectares, placing it in the 'extra-large' patch size class in accordance with the FBA.
Area to perimeter ratio	Linear projects are required to assess the change in area to perimeter ratio of vegetation patch size areas that are impacted by the project in accordance with the FBA. The BAR identified a proportional change in area to perimeter ratio of 8.6 per cent. This relatively small change in area to perimeter ratio as a result of the project is due to the highly fragmented nature of the existing vegetation in and adjoining the construction footprint.

Commonwealth land

As part of the consideration of MNES, the assessment must consider impacts on Commonwealth land. The study area is directly adjacent to Commonwealth land at the Western Sydney Airport.

Certified and non-certified land

The project intersects the north-eastern corner of the South West Growth Area as defined under Growth Centres SEPP.

On 11 December 2007, an order conferring biodiversity certification on the Sydney Growth Centres SEPP was made by the Commonwealth Minister for the Environment under Section 126G of the TSC Act. Under the terms of the Biodiversity Certification Order, any developments or activities proposed to be carried out within certified areas do not need to carry out an assessment of impacts on threatened species, populations and ecological communities, or their habitats, that would normally be required by Parts 3, 4 or 5 of the EP&A Act. Development within non-certified land within the Growth Centres requires assessment under normal legislative requirements. Non-certified areas in the Growth Centres are identified on the maps in Schedule 2 of the Biodiversity Certification Order.

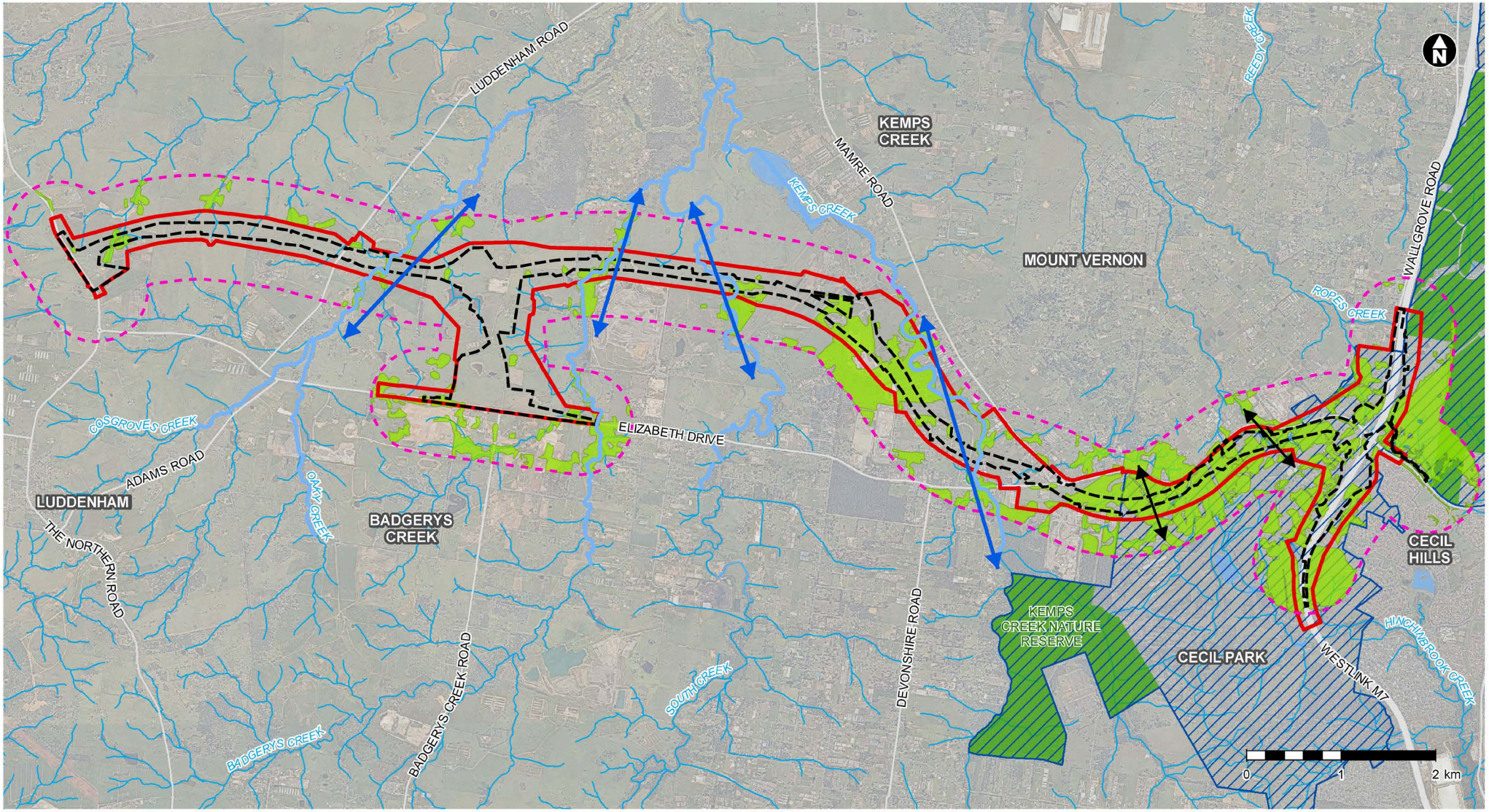
Of the 83.5 hectares of the South-west Growth Centre within the construction footprint, 66.15 hectares consists of non-certified land and 17.38 hectares consists of certified land. The 17.38 hectares of certified land within the construction footprint comprises a linear corridor adjoining Elizabeth Drive, land south of Elizabeth Drive and west of Range Road. Of the 17.38 hectares, 4.1 hectares are located within the Western Sydney Parklands. The location of certified and non-certified land within the study area is shown in **Figure 7-4**.

In addition, within the certified areas about 1.43 hectares are classed as ENV, as defined under the Biodiversity Certification Order. There is no ENV in non-certified areas located within the construction footprint.

The Biodiversity Certification Order of the Growth Centres SEPP has specific requirements for offsetting any clearance of ENV on 'non-certified' land, however, the project is not impacting any ENV as defined under Schedule 1 of the Biodiversity Certification Order on the non-certified land.

Biobanking site

A portion of the study area in the Western Sydney Parklands located to the south-west of the M7 Motorway and Elizabeth Drive intersection is the subject of a Biobanking agreement under Part 7A Division 2 of the TSC Act. This Biobank site (ID number 119) is about 32.2 hectares in area, of which the eastern 17.06 hectares is within the study area, and 2.89 hectares is within the construction footprint (**Figure 7-5**).



*Entire map extent is covered by the IBRA 7 Region - Sydney Basin,and IBRA 7 Subregion - Cumberland. No SEPP 14 Coastal Wetlands or Ramsar Wetlands are present in the entire map extent.

Figure 7-3 Habitat corridors

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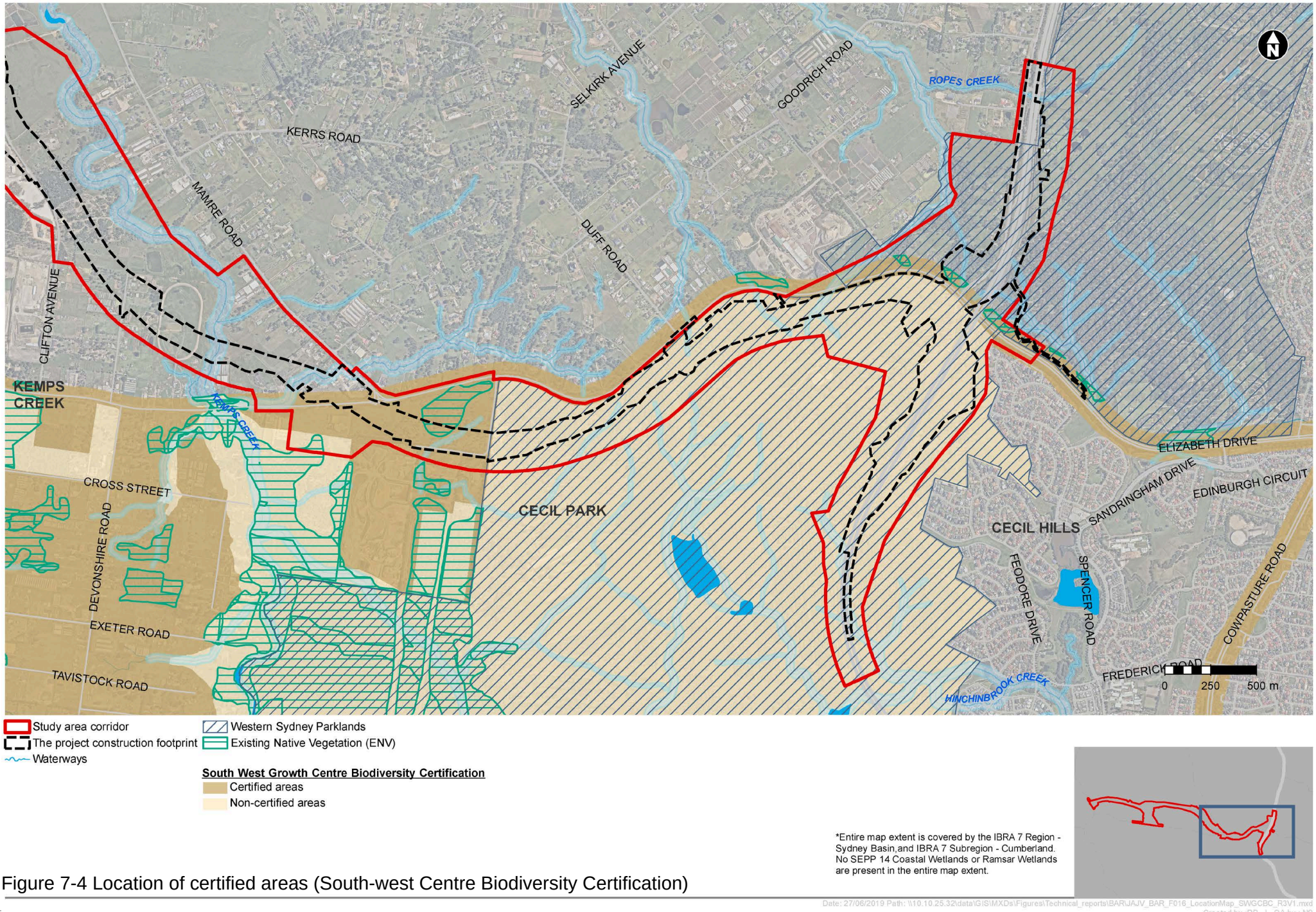


Figure 7-4 Location of certified areas (South-west Centre Biodiversity Certification)

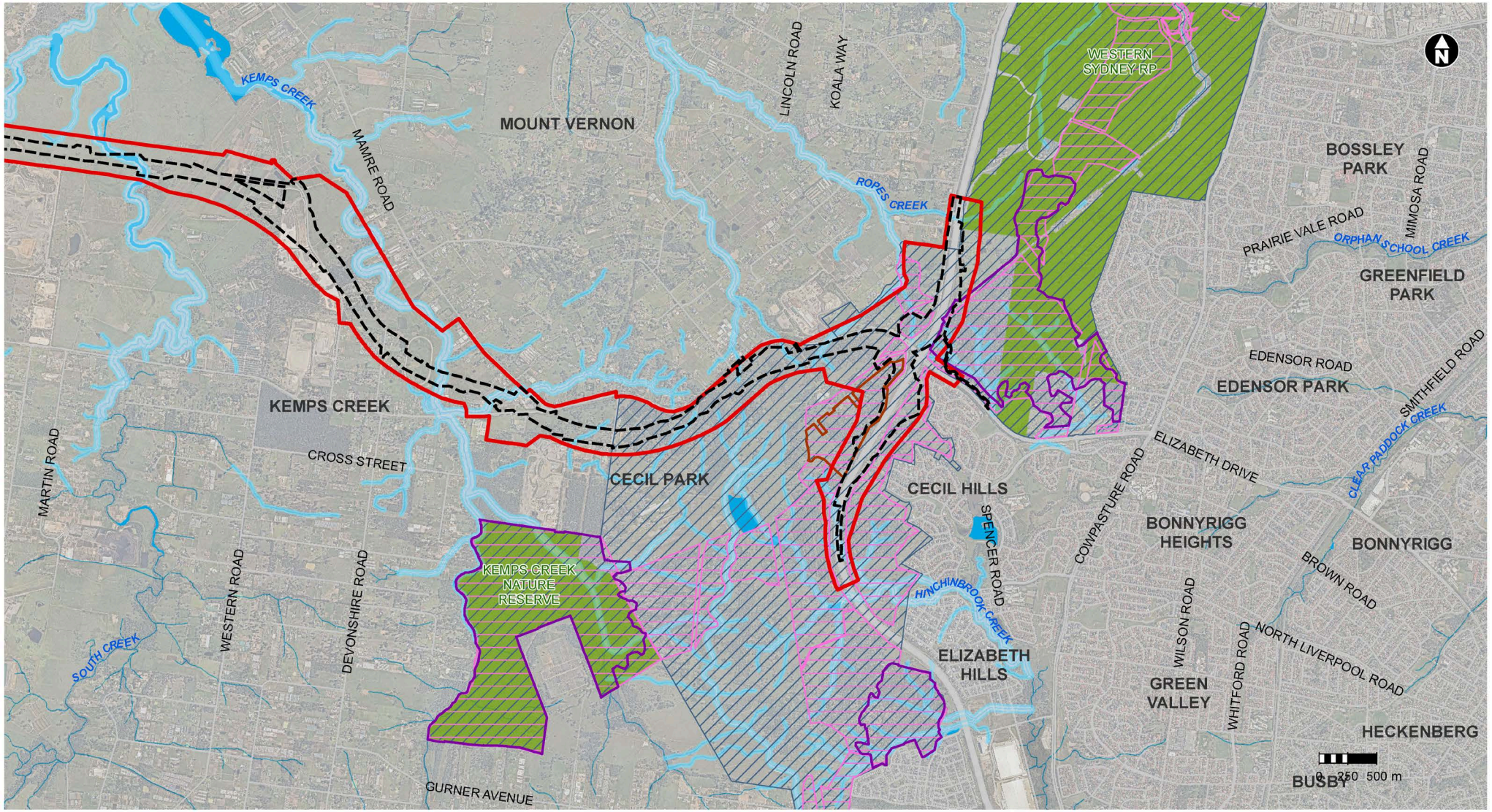


Figure 7-5 Location of biobank site

Terrestrial flora

Native vegetation communities

The FBA requires the extent of native vegetation within the 'development site' (defined in this assessment as the construction footprint) to be mapped. This native vegetation is then classified into PCTs, as defined in the BioNet Vegetation Classification database.

The vegetation in the study area has a long history of disturbance and some areas were replanted. Following desktop review and ground truthing, eight different PCTs were identified in the study area, of which seven PCTs are mapped within the construction footprint. PCTs located within the study area and construction footprint are described in **Figure 7-5**.

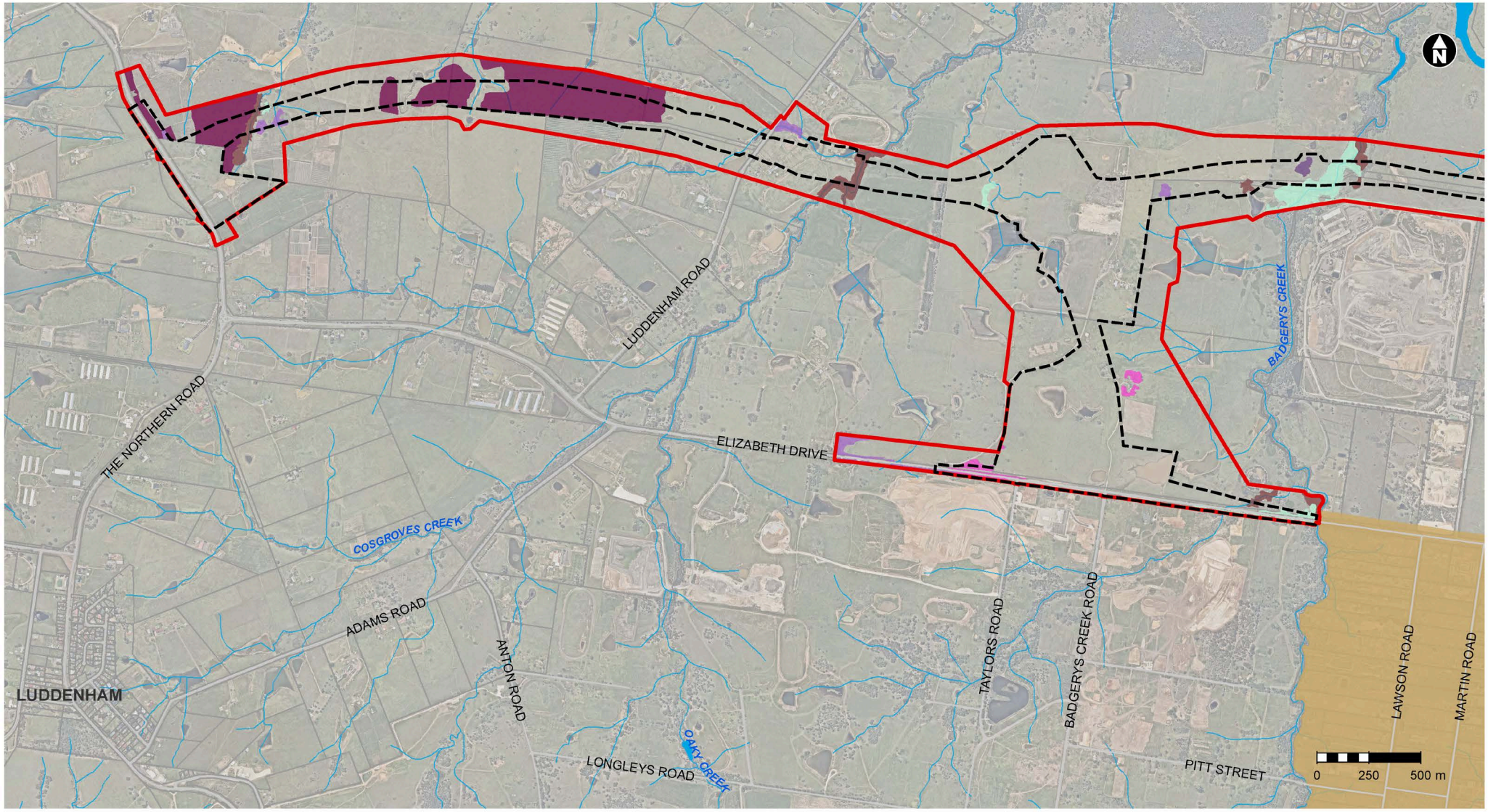
Vegetation zones for each PCT were determined based on a review of the condition of the native vegetation. Fourteen vegetation zones were identified within the seven PCTs within the construction footprint (see **Table 7-8**, overleaf). The location of PCTs and their respective vegetation zones are presented in **Figure 7-6**. A description of each vegetation zone is provided in **Appendix E**.

Table 7-7 PCTs identified within the study area and construction footprint

PCT No	PCT name	Area (ha) within study area	Area (ha) within construction footprint	Area (ha) within construction footprint excluding certified area
724	Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	12.82	6.91	6.91
725	Broad-leaved Ironbark - *Melaleuca decora* shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	0.50	0	0
830	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	4.97	0.44	0.44
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	20.70	3.23	3.23
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	18.11	6.59	6.09
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (includes revegetation within Western Sydney Parklands and derived grasslands in Low condition)	154.44	61.76	54.07
883	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	0.93	0.38	0.38
1800	Swamp Oak open forest on river flats of the Cumberland Plain and Hunter valley	16.00	2.53	2.53
Total		**228.47**	**81.84**	**73.65**

Table 7-8 Vegetation zones within construction footprint

PCT No.	PCT name	Vegetation zone code	Vegetation zone code within construction footprint	Area within construction footprint excluding certified area (ha)
724	Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	1	724 - Moderate/ Good_High	3.50
		2	724 - Moderate/ Good_Medium	2.96
		3	724 - Moderate/ Good_Poor	0.45
830	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	4	830 - Moderate/ Good_Poor	0.44
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	5	835 - Moderate/ Good_Poor	3.23
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	6	849 - Moderate/ Good_Medium	3.54
		7	849 - Moderate/ Good_Poor	2.07
		8	849 - Moderate/ Good_Other (Derived Shrubland)	0.48
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	9	850 - Moderate/ Good_High	3.21
		10	850 - Moderate/ Good_Medium	10.14
		11	850 - Moderate/ Good_Other (Revegetation)	22.65
		12	850 -Low	18.07
883	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	13	883 - Poor	0.38
1800	Swamp Oak open forest on river flats of the Cumberland Plain and Hunter Valley	14	1800 - Moderate/ Good_Poor	2.53
Total				**73.65**



Study area corridor
The project construction footprint
Western Sydney Parklands
NPWS Reserves
Biodiversity certified land
Cadastre
Waterways

Vegetation Zones

725 - Moderate/Good -Medium
724 - Moderate/Good - High
724 - Moderate/Good - Medium
724 - Moderate/Good - Poor
830 - Moderate/Good - Poor
835 - Moderate/Good - Poor
849 - Moderate/Good - Medium
849 - Moderate/Good - Poor
849 - Moderate/Good - Other (Derived Shrubland)
850 - Moderate/Good - High
850 - Moderate/Good - Medium
850 - Low
850 - Moderate/Good -Other (Revegetation)
883 - Poor
1800 - Moderate/Good - Poor

Figure 7-6 PCT and vegetation zones within the study area

Page 1 of 3

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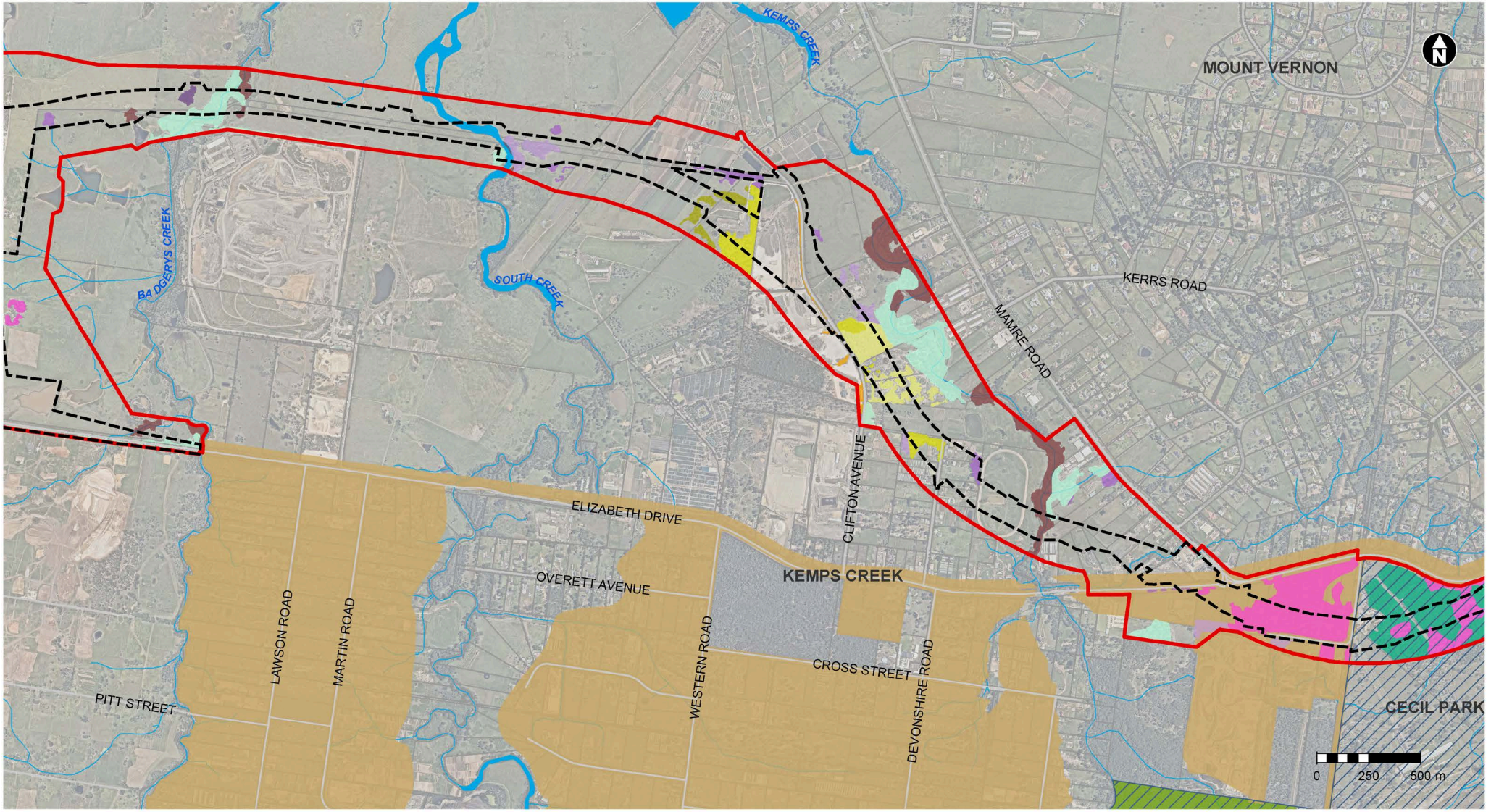

Figure 7-6 PCT and vegetation zones within the construction footprint

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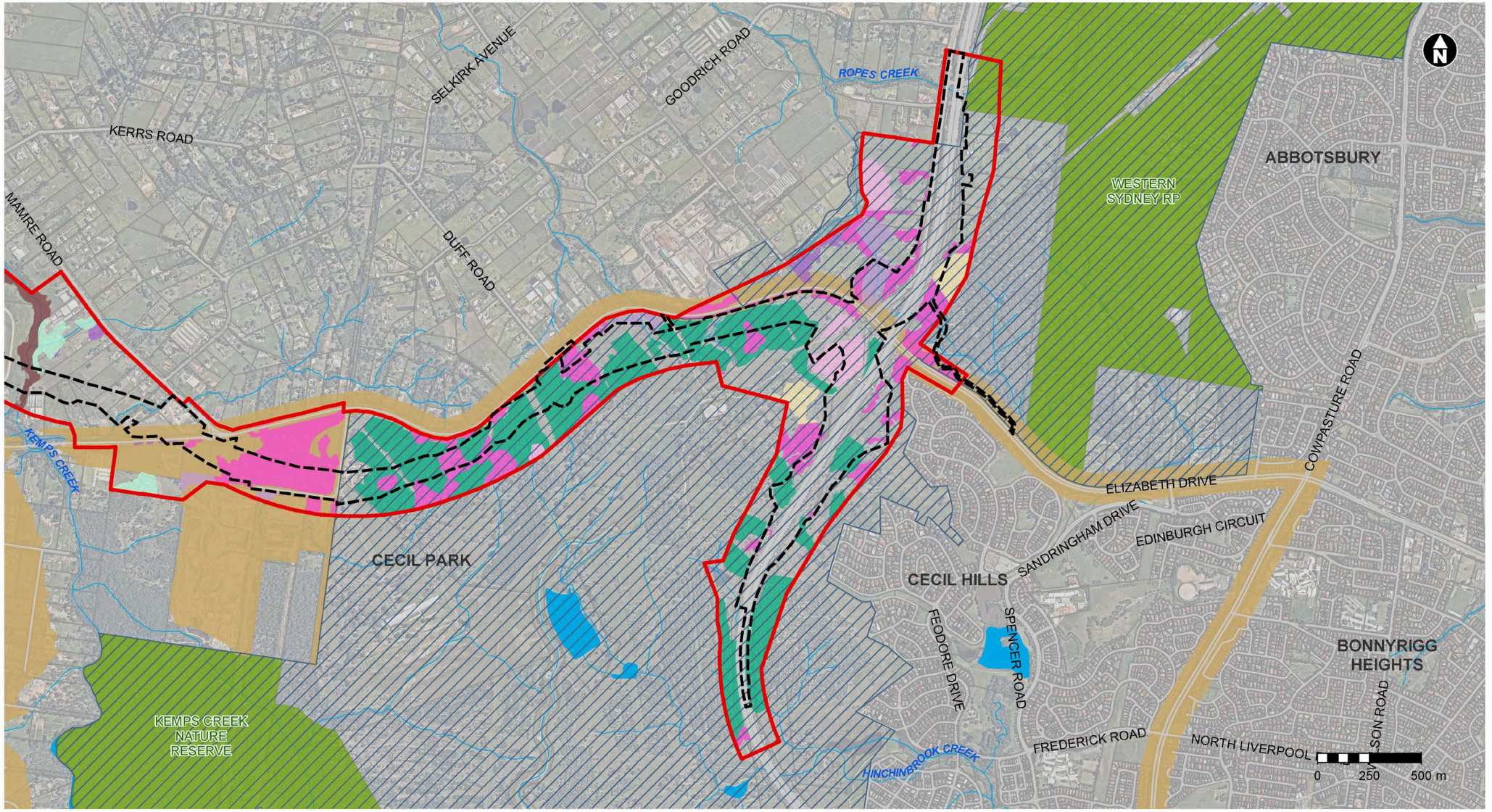

Study area corridor
The project construction footprint
Western Sydney Parklands
NPWS Reserves
Biodiversity certified land
Cadastre
Waterways

Vegetation Zones

- 725 - Moderate/Good -Medium
- 724 - Moderate/Good - High
- 724 - Moderate/Good - Medium
- 724 - Moderate/Good - Poor
- 830 - Moderate/Good - Poor
- 835 - Moderate/Good - Poor
- 849 - Moderate/Good - Medium
- 849 - Moderate/Good - Poor
- 849 - Moderate/Good - Other (Derived Shrubland)
- 850 - Moderate/Good - High
- 850 - Moderate/Good - Medium
- 850 - Low
- 850 - Moderate/Good -Other (Revegetation)
- 883 - Poor
- 1800 - Moderate/Good - Poor

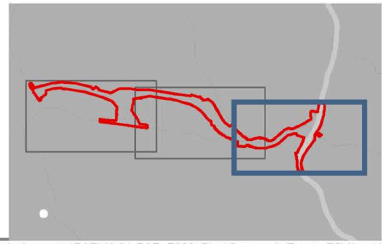

Figure 7-6 PCT and vegetation zones within the construction footprint

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TECs listed under the TSC Act

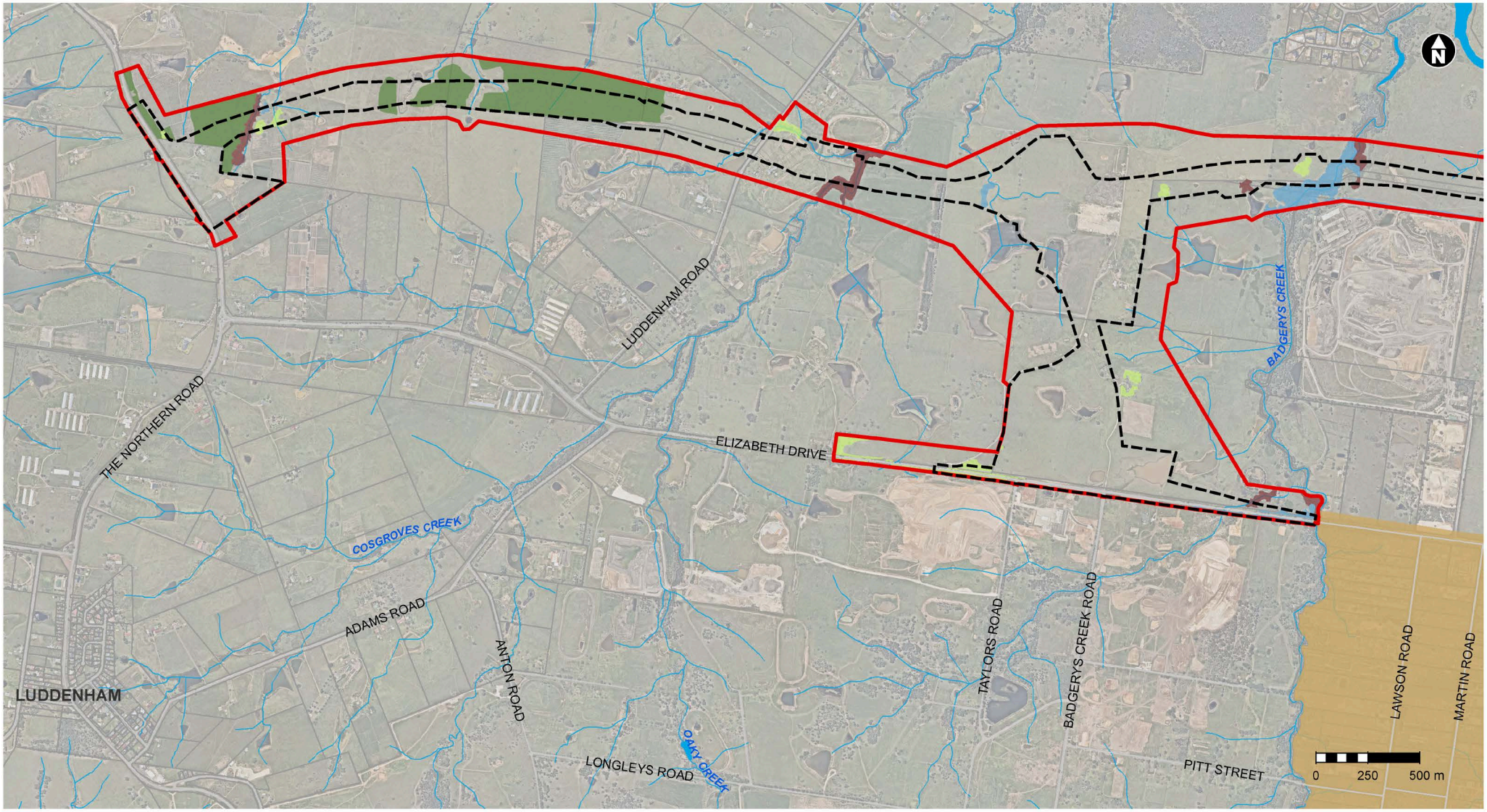
Seven PCTs meet the condition thresholds for six listed TECs under the TSC Act. Of these, five TECs are located within the construction footprint (see **Table 7-9**). The location of the TECs within the study area and construction footprint are presented in **Figure 7-7**.Total area and areas excluding certified land within the construction footprint are shown in **Table 7-9**. As previously discussed, these are shown separately as any developments or activities proposed to be carried out within certified areas do not need to carry out assessment of impacts on threatened species, populations and ecological communities, or their habitats. Development within non-certified land within the Growth Centres requires assessment under normal legislative requirements.

Table 7-9 TECs listed under the TSC Act identified within the study area and construction footprint

PCT(s)	TEC name	TSC Act status	Area within study area (ha)	Area within construction footprint (ha)	Area within construction footprint excluding certified area (ha)
724	Shale Gravel Transition Forest in the Sydney Basin Bioregion	E	12.82	6.91	6.91
725	Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion	E	0.50	0	0
830	Moist Shale Woodland in the Sydney Basin Bioregion	E	4.97	0.44	0.44
835	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E	20.70	3.23	3.23
849 850	Cumberland Plain Woodland in the Sydney Basin Bioregion	CE	172.55 (includes about 66.02 ha of revegetation and about 31.33 ha of derived native grassland in Low condition)	68.35 (includes about 22.74 ha of revegetation and about 18.07 ha of derived native grassland in Low condition)	60.16 (includes about 22.65 ha of revegetation and about 18.07 ha of derived native grassland in Low condition)
1800	Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	E	16.00	2.53	2.53
Total			**227.54**	**81.46**	**73.27**

CE = Critically Endangered, E = Endangered

On 11 December 2007, an order conferring biodiversity certification on the Sydney Growth Centres SEPP was made by the Commonwealth Minister for the Environment under Section 126G of the TSC Act. Under the terms of the Biodiversity Certification Order, any developments or activities proposed to be carried out within certified areas do not need to carry out assessment of impacts on threatened species, populations and ecological communities, or their habitats, that would normally be required by Parts 3, 4 or 5 of the EP&A Act. Development within non-certified land within the Growth Centres requires assessment under normal legislative requirements. Non-certified areas in the Growth Centres are identified on the maps in Schedule 2 of the Biodiversity Certification Order.



Study area corridor
The project construction footprint
Western Sydney Parklands
NPWS Reserves
Cadastre
Waterways
Biodiversity certified land

Threatened Ecological Communities (TEC)

Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion
Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion
Cumberland Plain Woodland in the Sydney Basin Bioregion
Cumberland Plain Woodland in the Sydney Basin Bioregion (derived grassland form)
Moist Shale Woodland in the Sydney Basin Bioregion
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
Shale Gravel Transition Forest in the Sydney Basin Bioregion
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

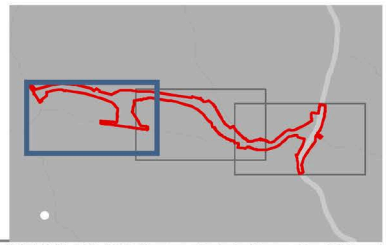


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Figure 7-7 TECs listed under the TSC Act within the study area

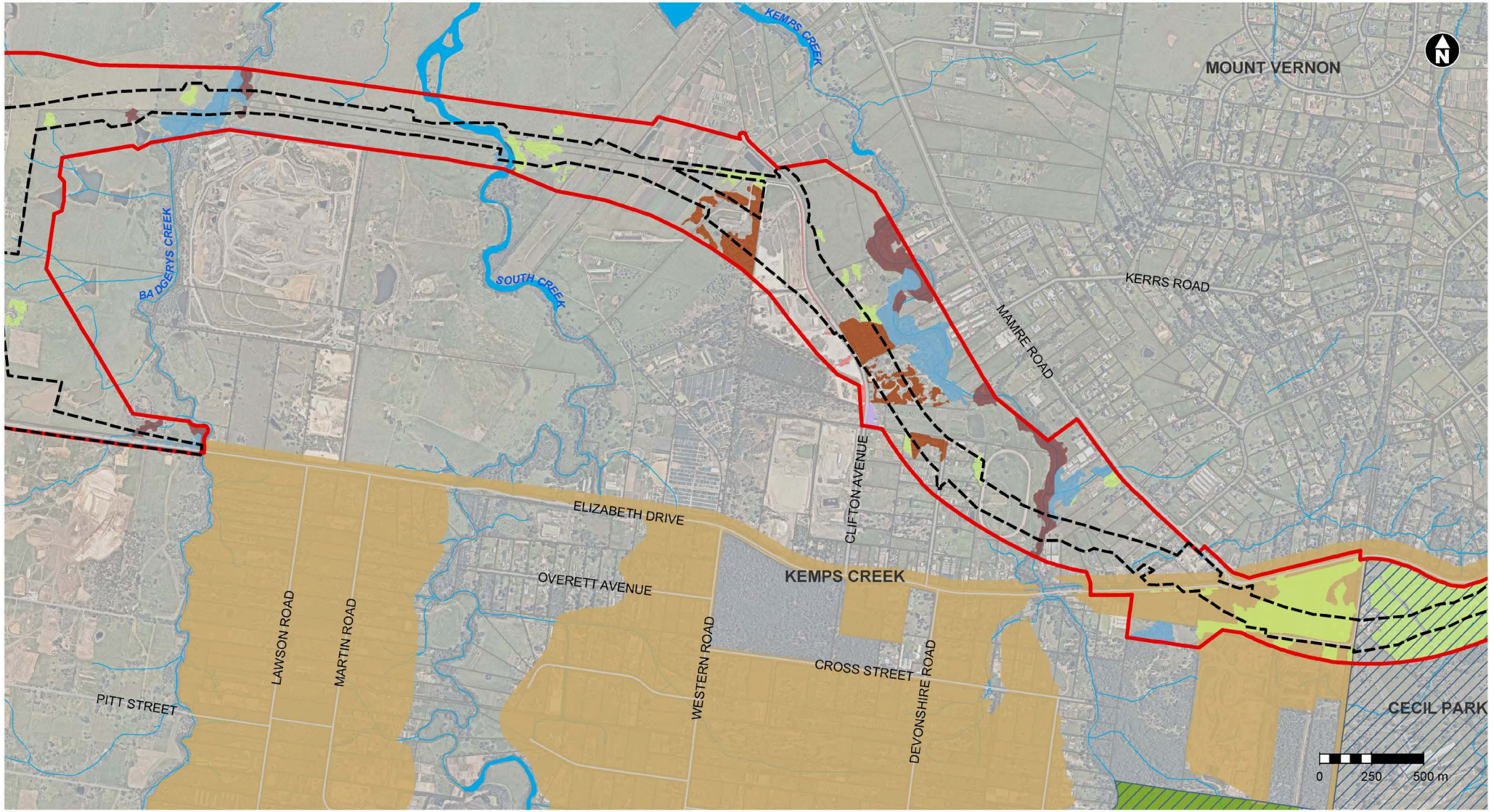

Figure 7-7 TECs listed under the TSC Act within the study area

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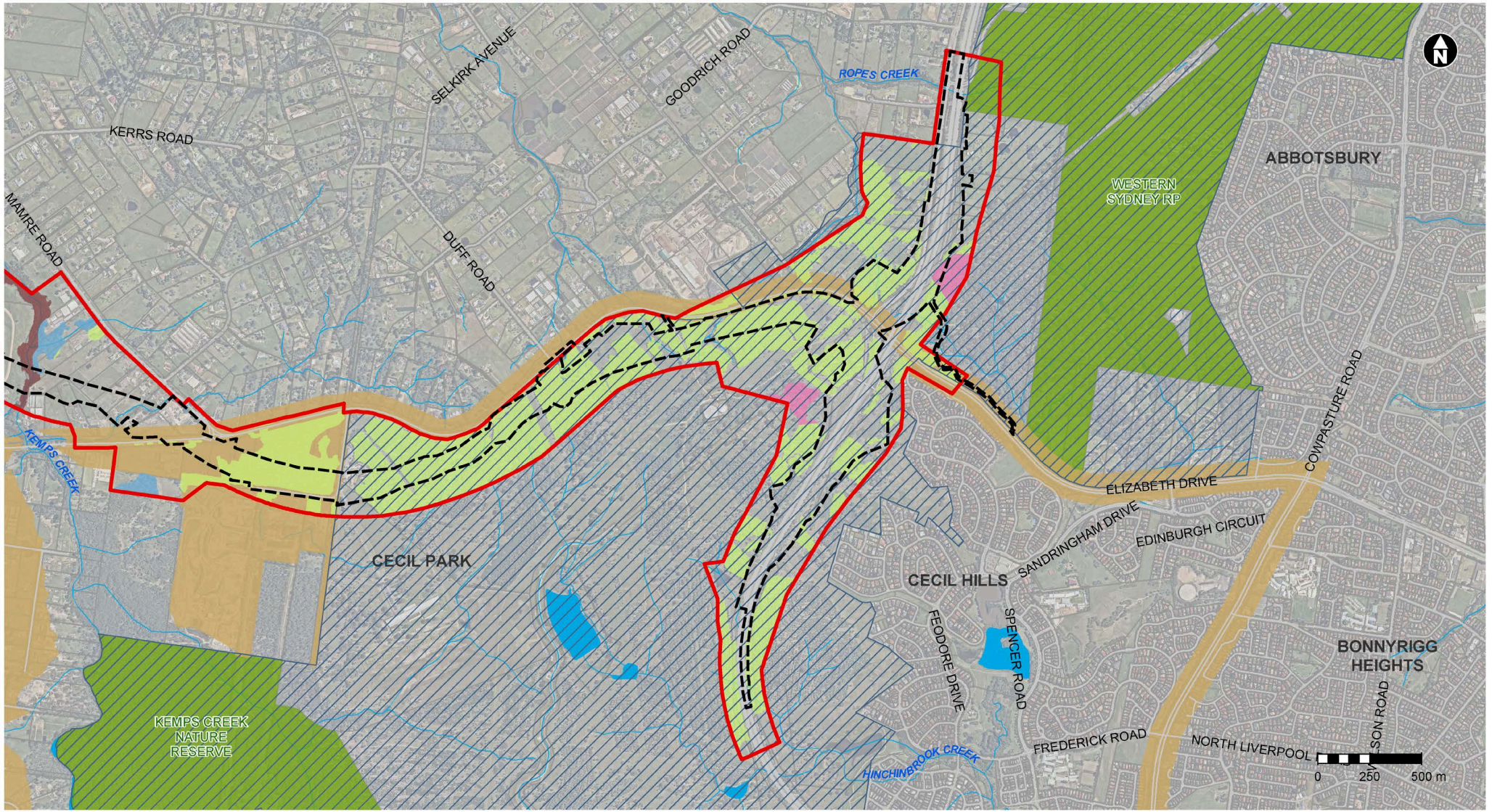

Figure 7-7 TECs listed under the TSC Act within the study area

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Of the 83.5 hectares of the South-west Growth Centre within the construction footprint, 66.15 hectares consists of non-certified land and 17.38 hectares consists of certified land. The 17.38 hectares of certified land located within the construction footprint is comprised of a linear corridor adjoining Elizabeth Drive, land south of Elizabeth Drive and west of Range Road. Of the 17.38 hectares, 4.1 hectares are located within the Western Sydney Parklands. The location of certified land within the study area is shown in **Figure 7-4**.

TECs listed under the EPBC Act

Two TECs within the study area also meet the criteria for listing under the EPBC Act: *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* and *Western Sydney Dry Rainforest and Moist Woodland on Shale*. *Cumberland Plain Shale Woodlands* is listed as a Critically Endangered Ecological Community (CEEC) and *Western Sydney Dry Rainforest and Moist Woodland on Shale* is listed as an Endangered Ecological Community (EEC); both are present within the construction footprint.

The TECs are listed in **Table 7-10** and the location of the TECs within the study area and construction footprint are presented in **Figure 7-8**.

Table 7-10 TECs listed under the EPBC Act identified within the study area and construction footprint

PCT(s)	TEC name (EPBC Act)	EPBC Act Status	Extent within study area (ha)	Area within construction footprint (ha)	Area within construction footprint excluding certified areas
849 850 724	Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	128.39 (includes 63.18 ha of revegetation)	45.96 (includes 20.21 ha of revegetation)	38.48 (includes 20.21 ha of revegetation)
830	Western Sydney Dry Rainforest and Moist Woodland on Shale	CE	4.97	0.44	0.44
Total			**133.36**	**46.40**	**38.92**

CE = Critically Endangered, E = Endangered

Threatened flora species

The BioNet threatened species database searches identified 22 threatened plant species listed under the TSC Act and/or EPBC Act as being previously recorded within 10 kilometres of the study area.

A likelihood of occurrence assessment identified 12 threatened flora species as having a moderate to high likelihood of occurring in the study area, having regard to the vegetation types and habitats present. Five threatened flora species were recorded within the study area and/or within the construction footprint during targeted surveys. The threatened species recorded are presented in **Table 7-11** overleaf. Recorded locations of threatened species are shown in **Figure 7-9**.

Two threatened flora species recorded within the construction footprint are species credit species (as explained in **Section 7.1.2** under ‘Offsetting required’).

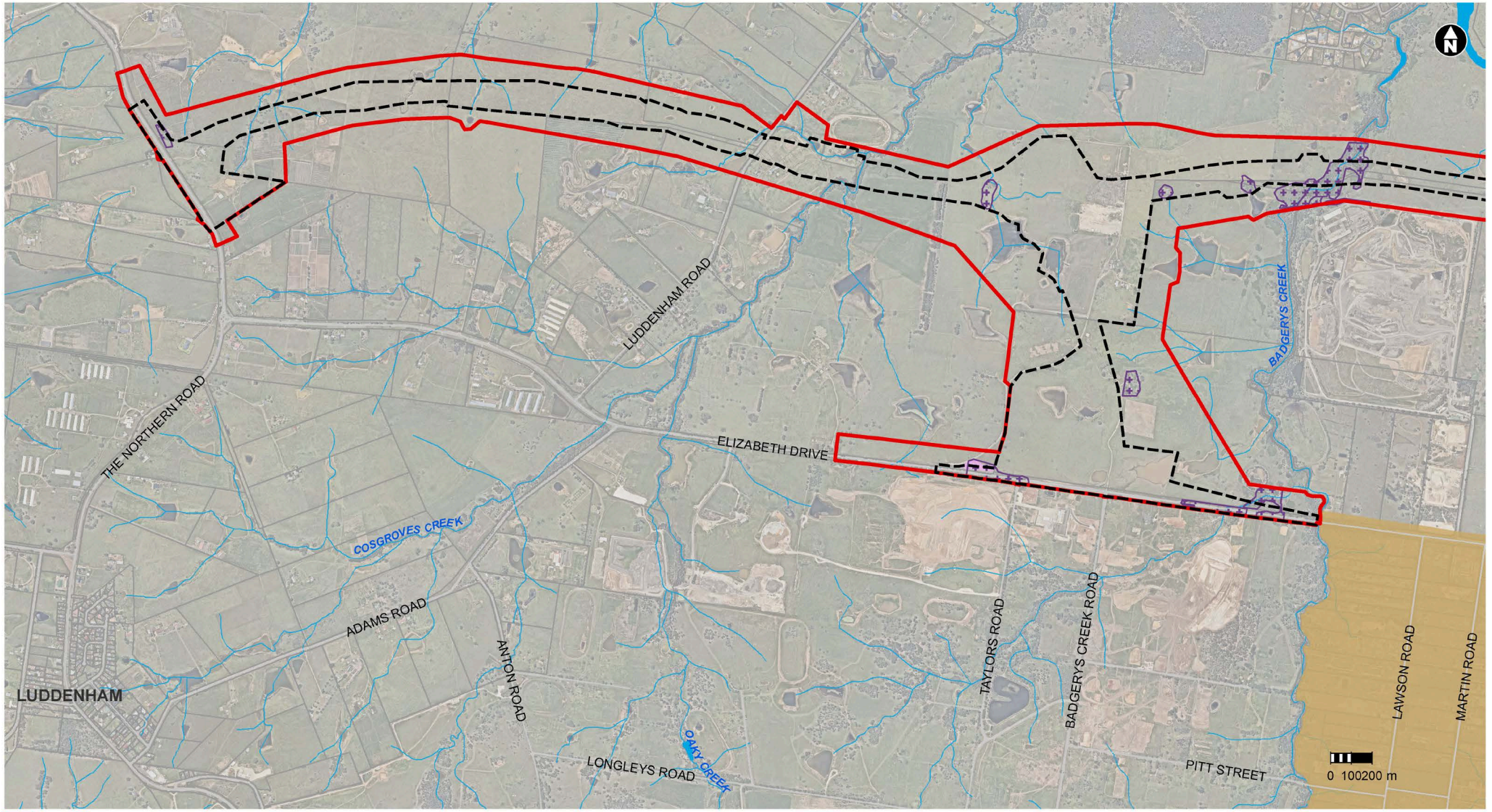

Figure 7-8 TECs listed under the EPBC Act

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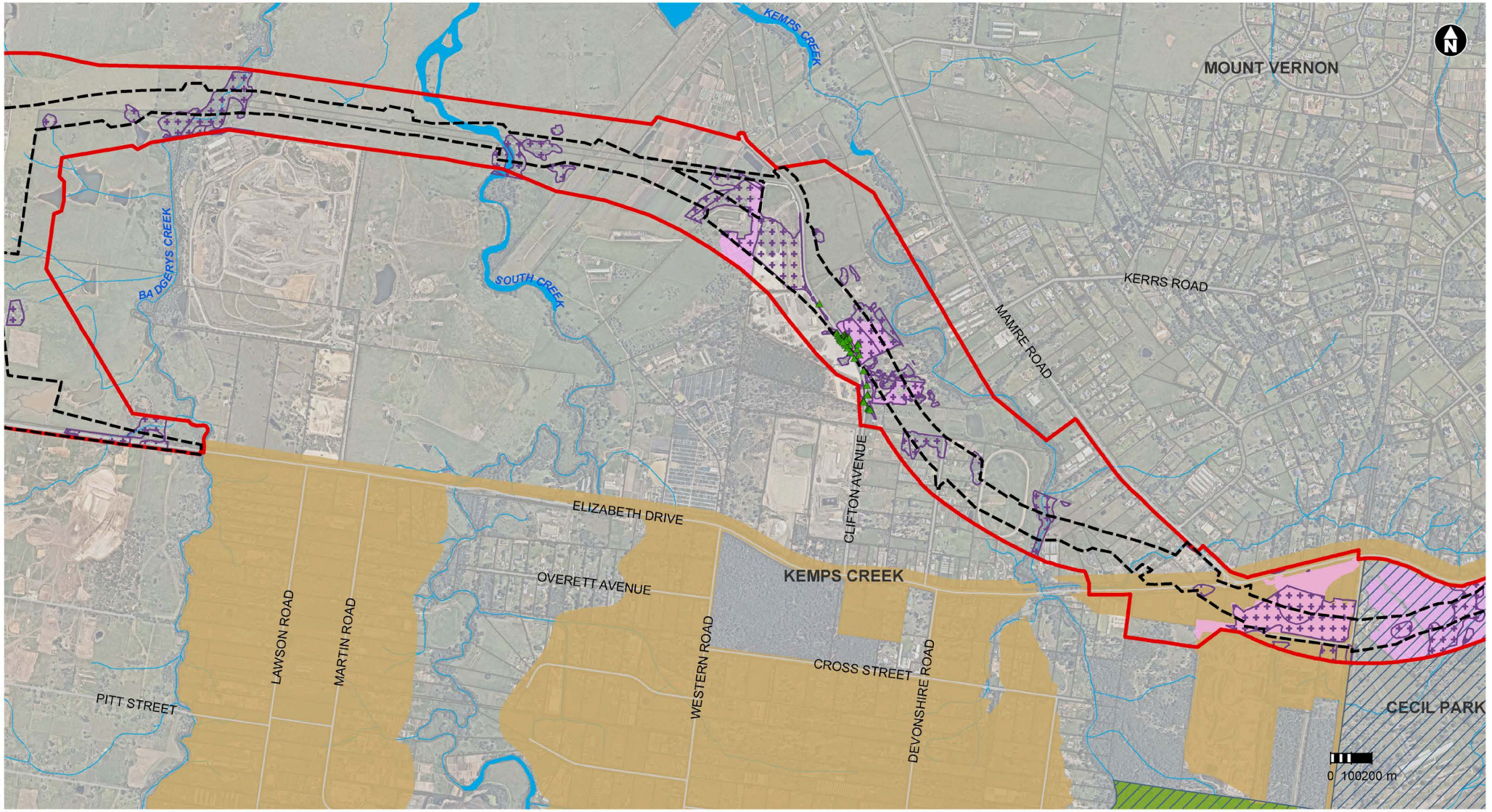

Figure 7-8 TECs listed under the EPBC Act

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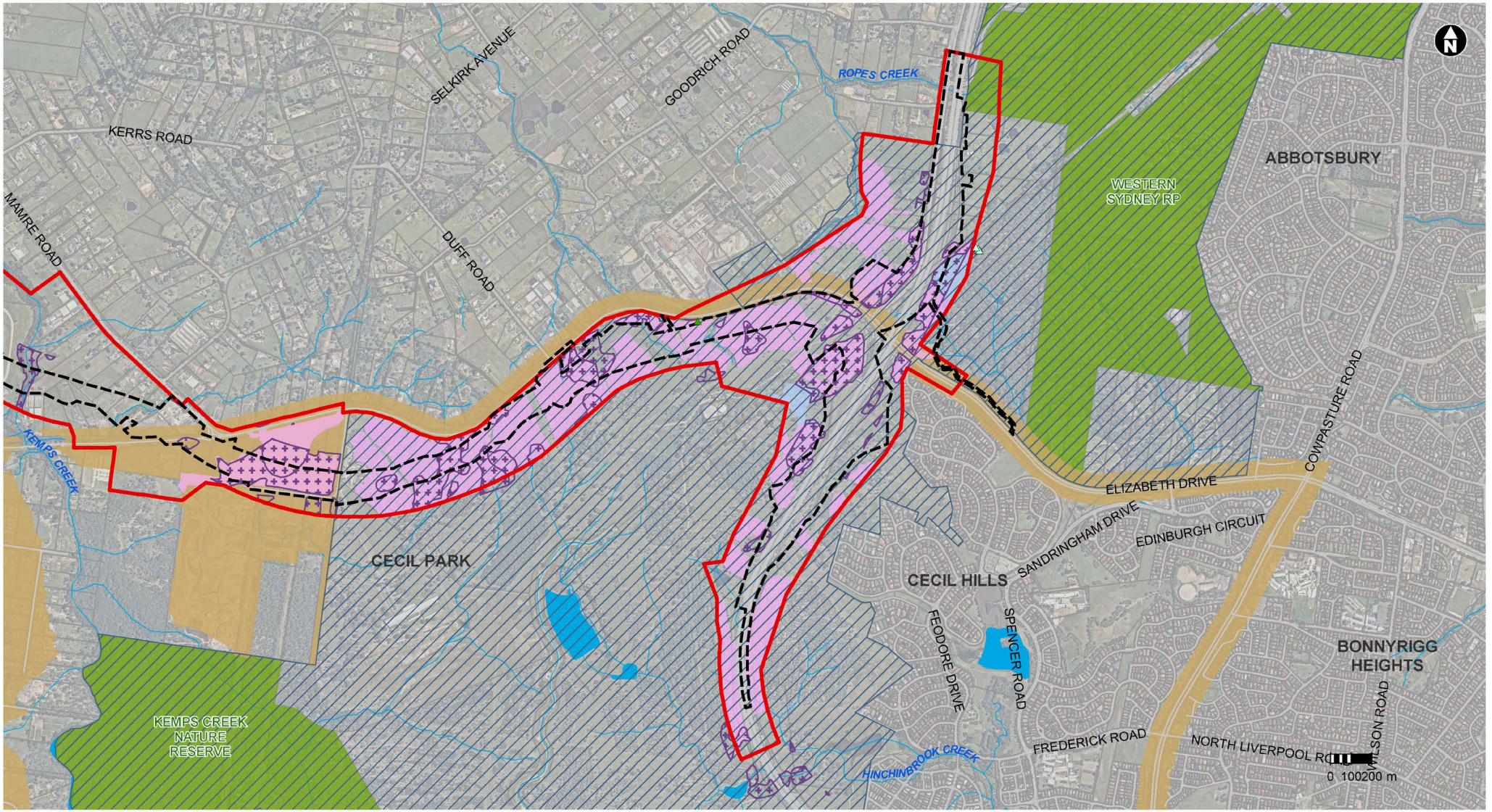

Figure 7-8 TECs listed under the EPBC Act

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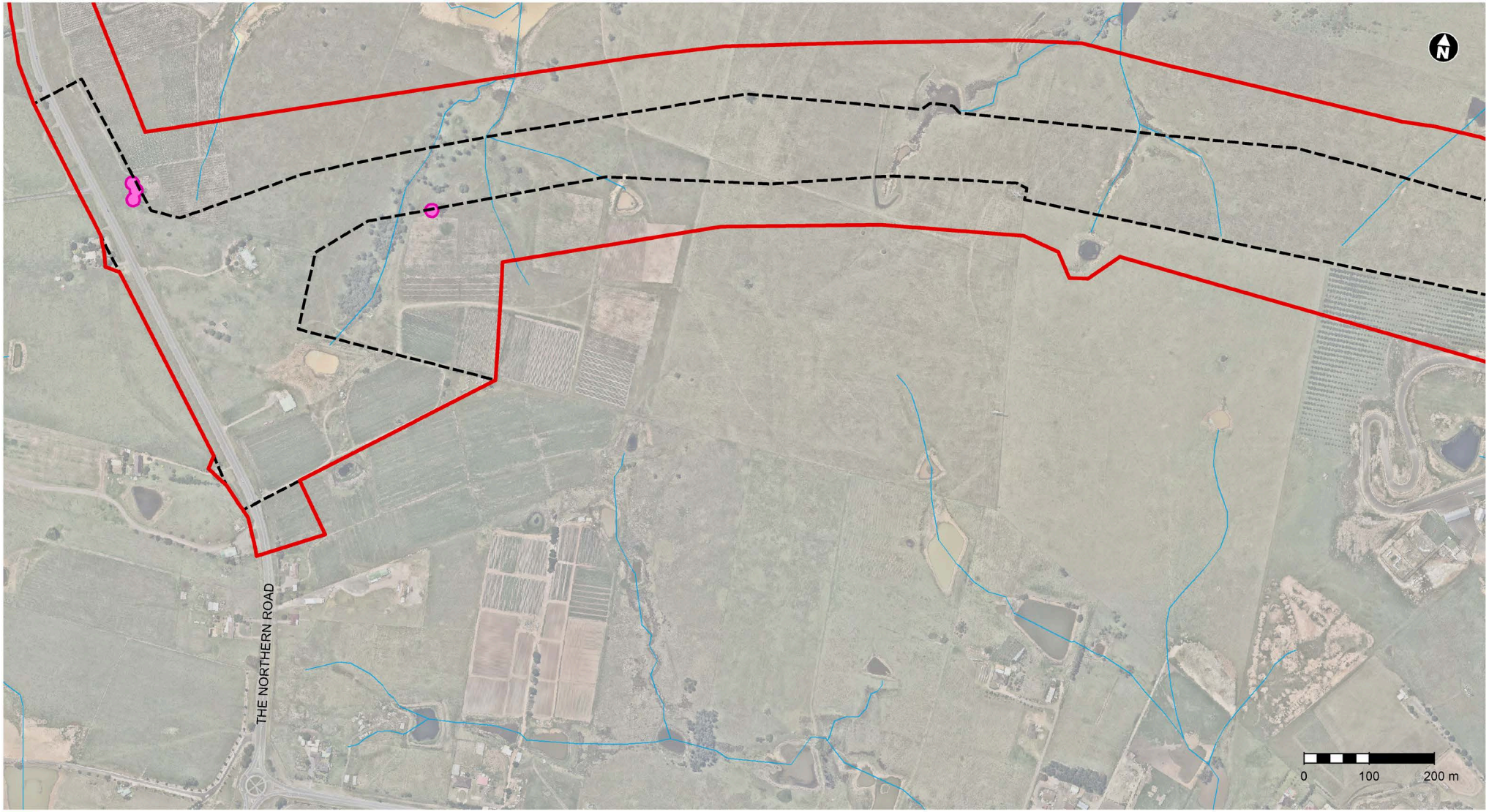

Figure 7-9 Recorded threatened species within the study area

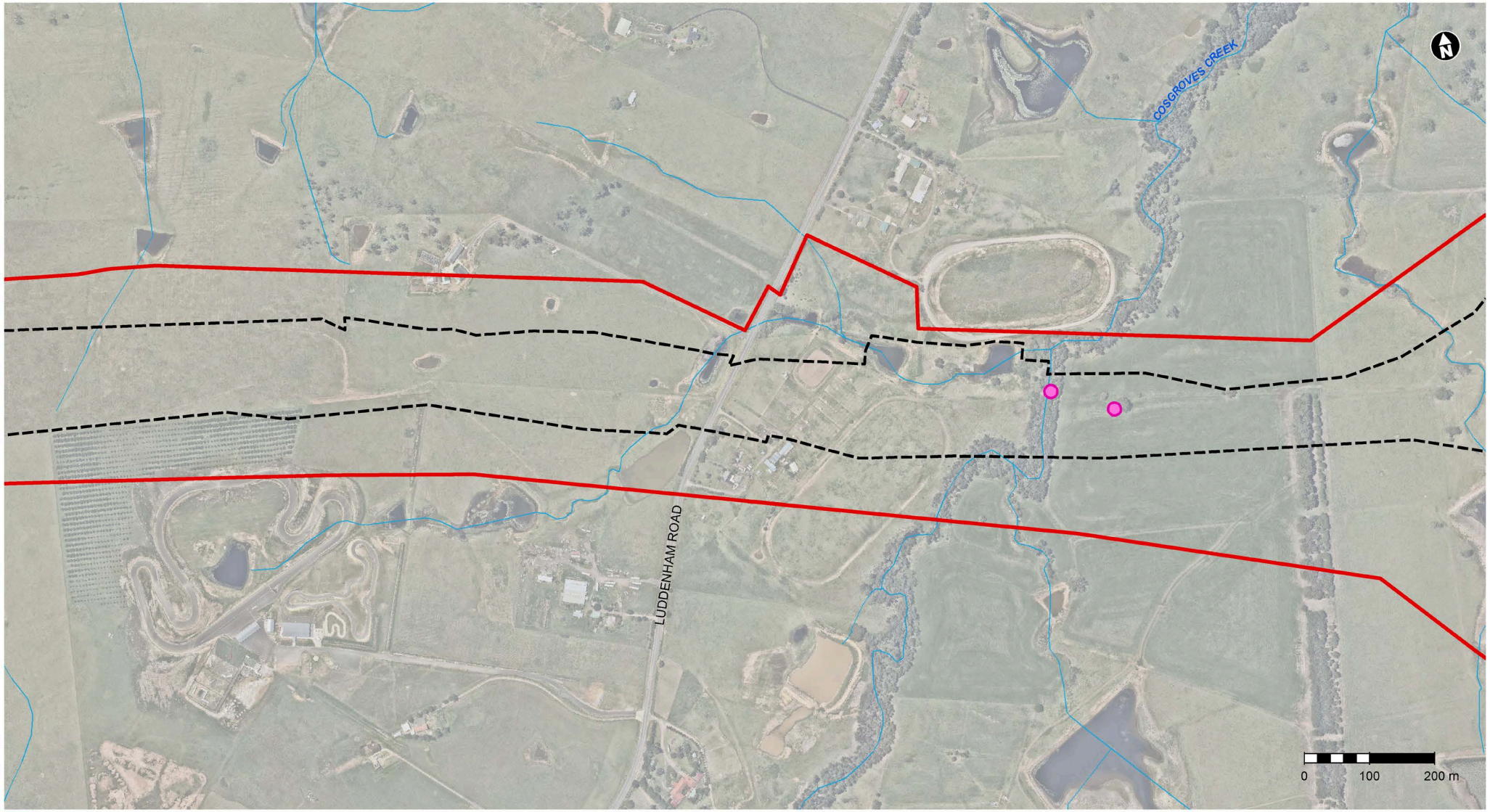

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Figure 7-9 Recorded threatened species within the study area

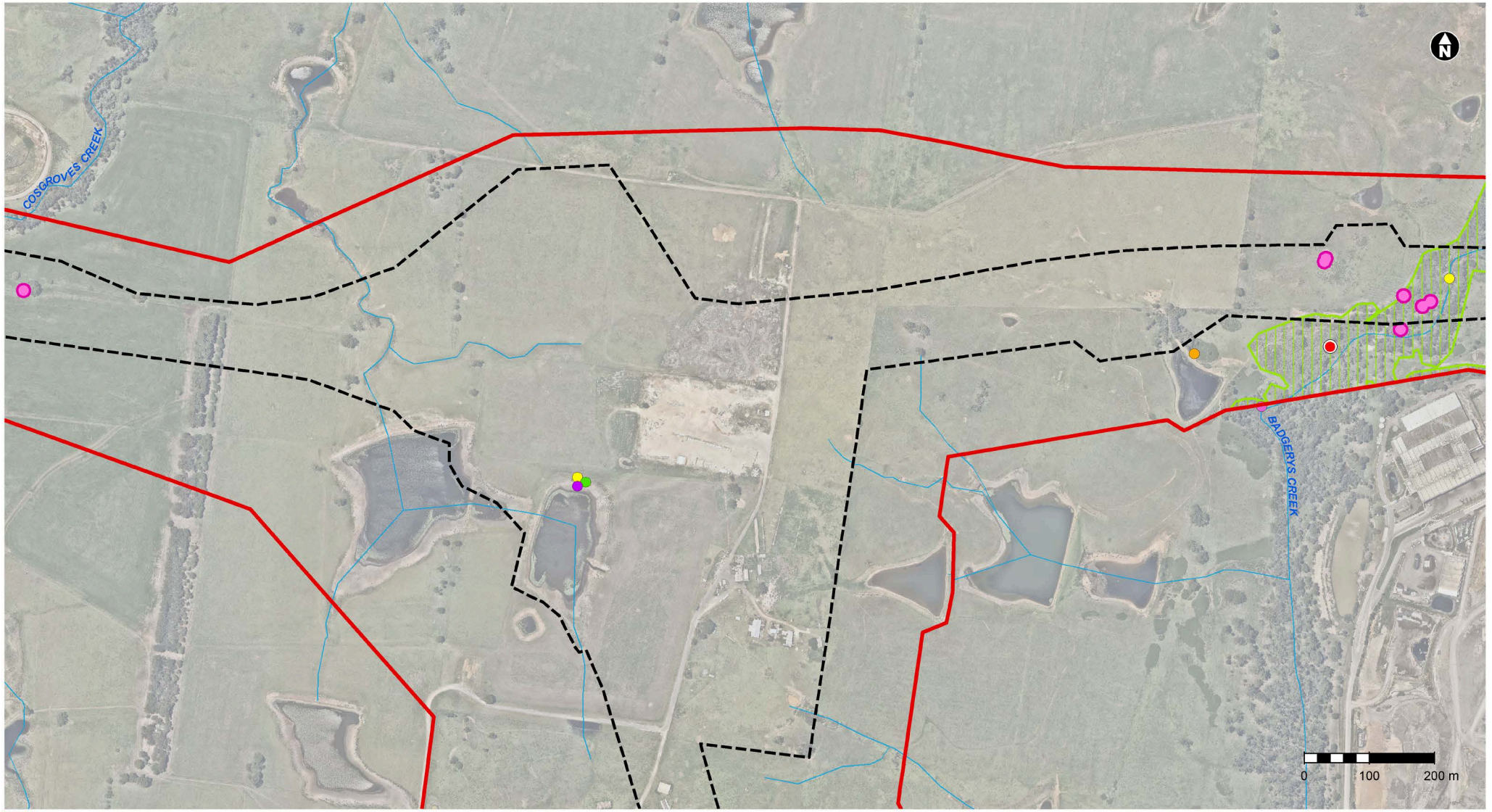

Figure 7-9 Recorded threatened species within the study area

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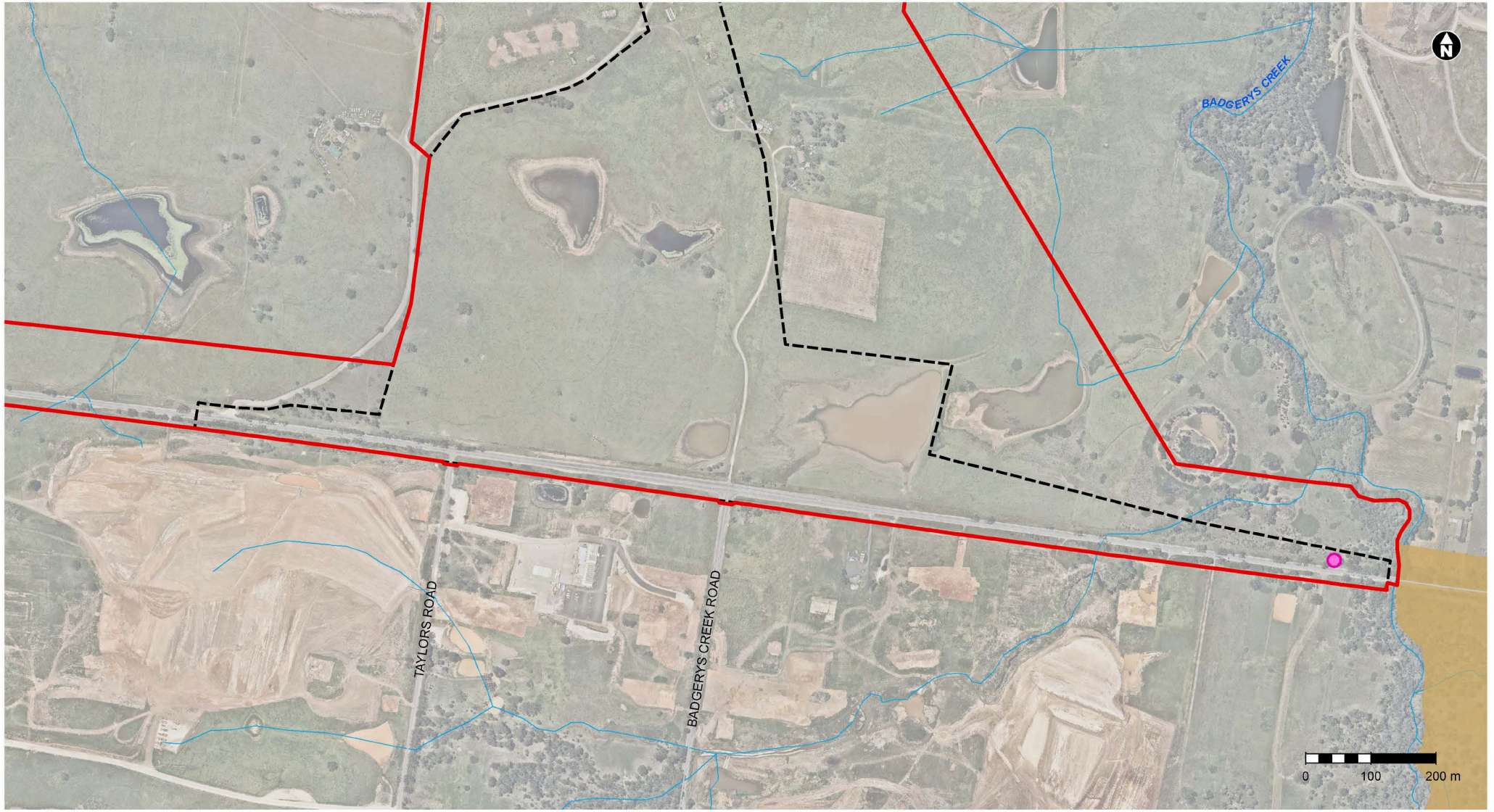

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Figure 7-9 Recorded threatened species within the study area

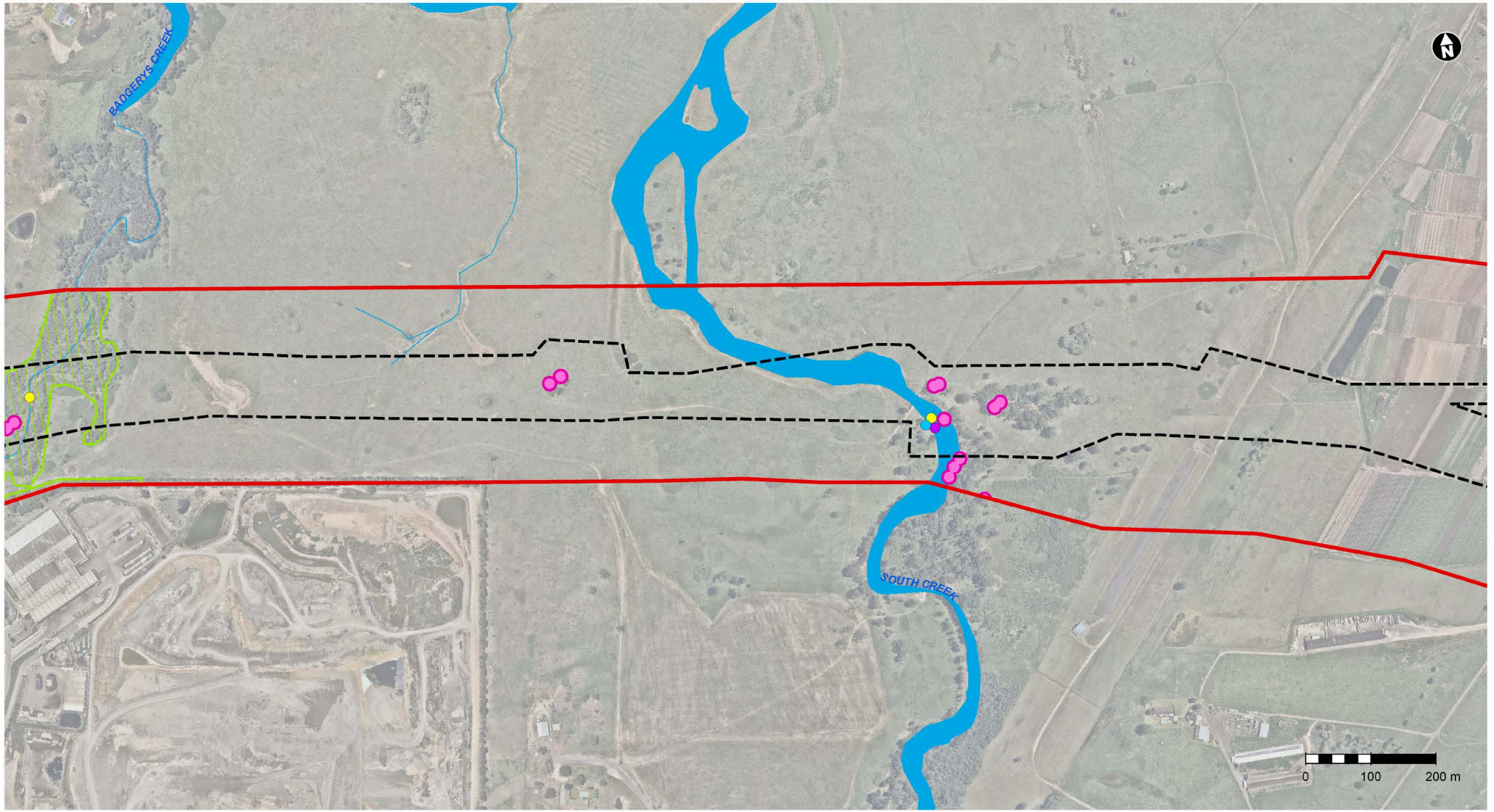

Figure 7-9 Recorded threatened species within the study area

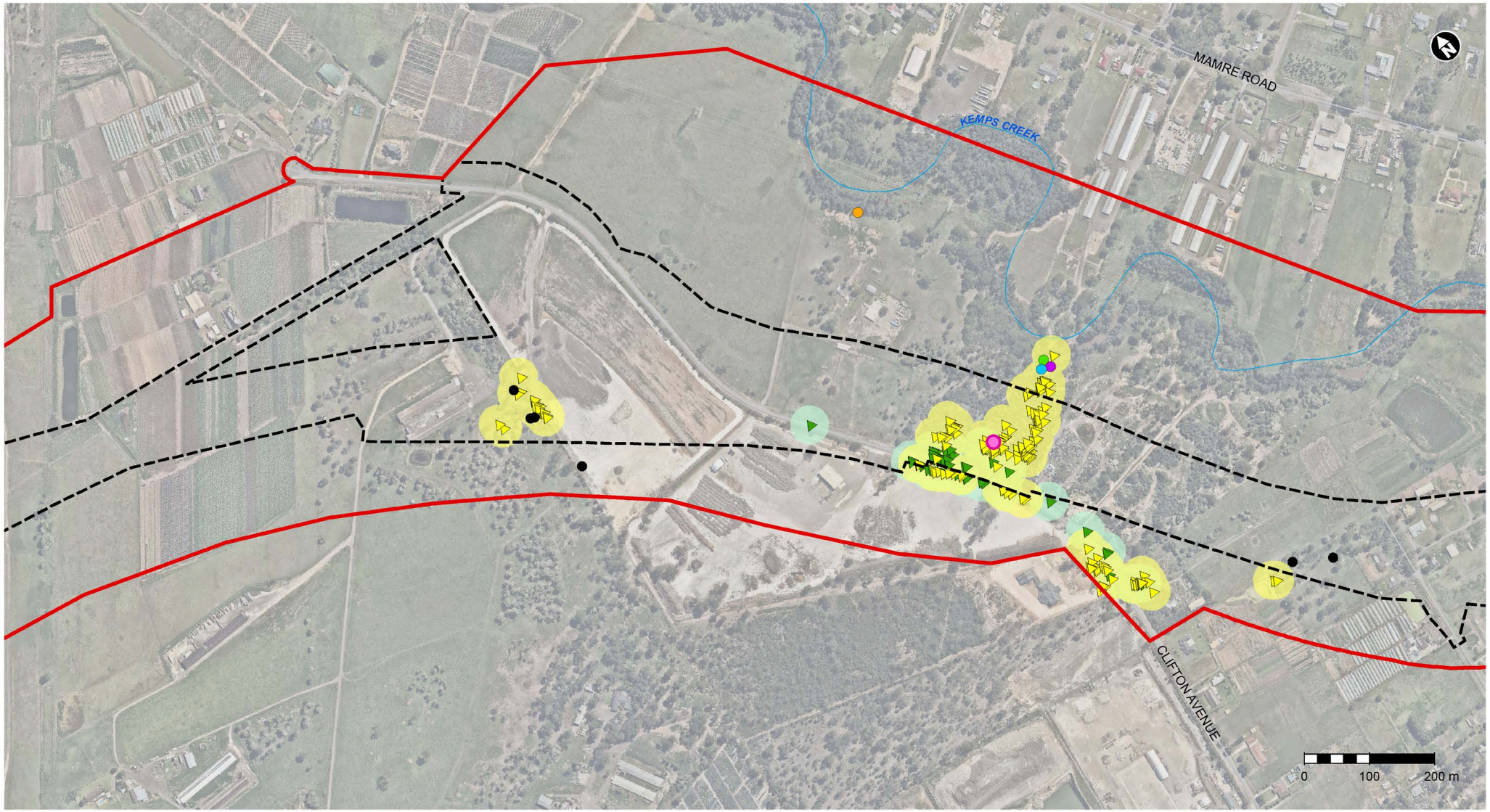

Figure 7-9 Recorded threatened species within the study area

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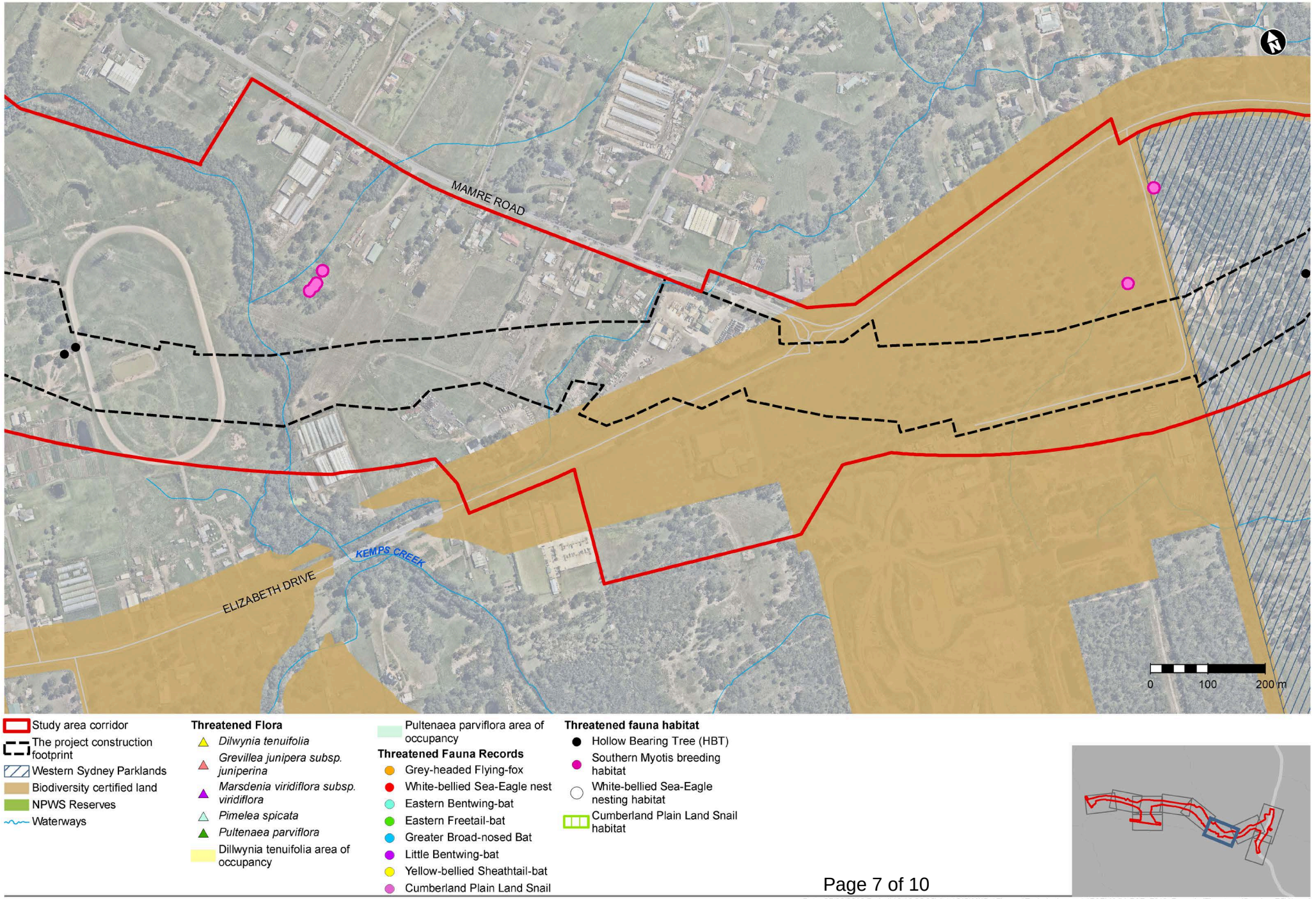

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Figure 7-9 Recorded threatened species within the study area

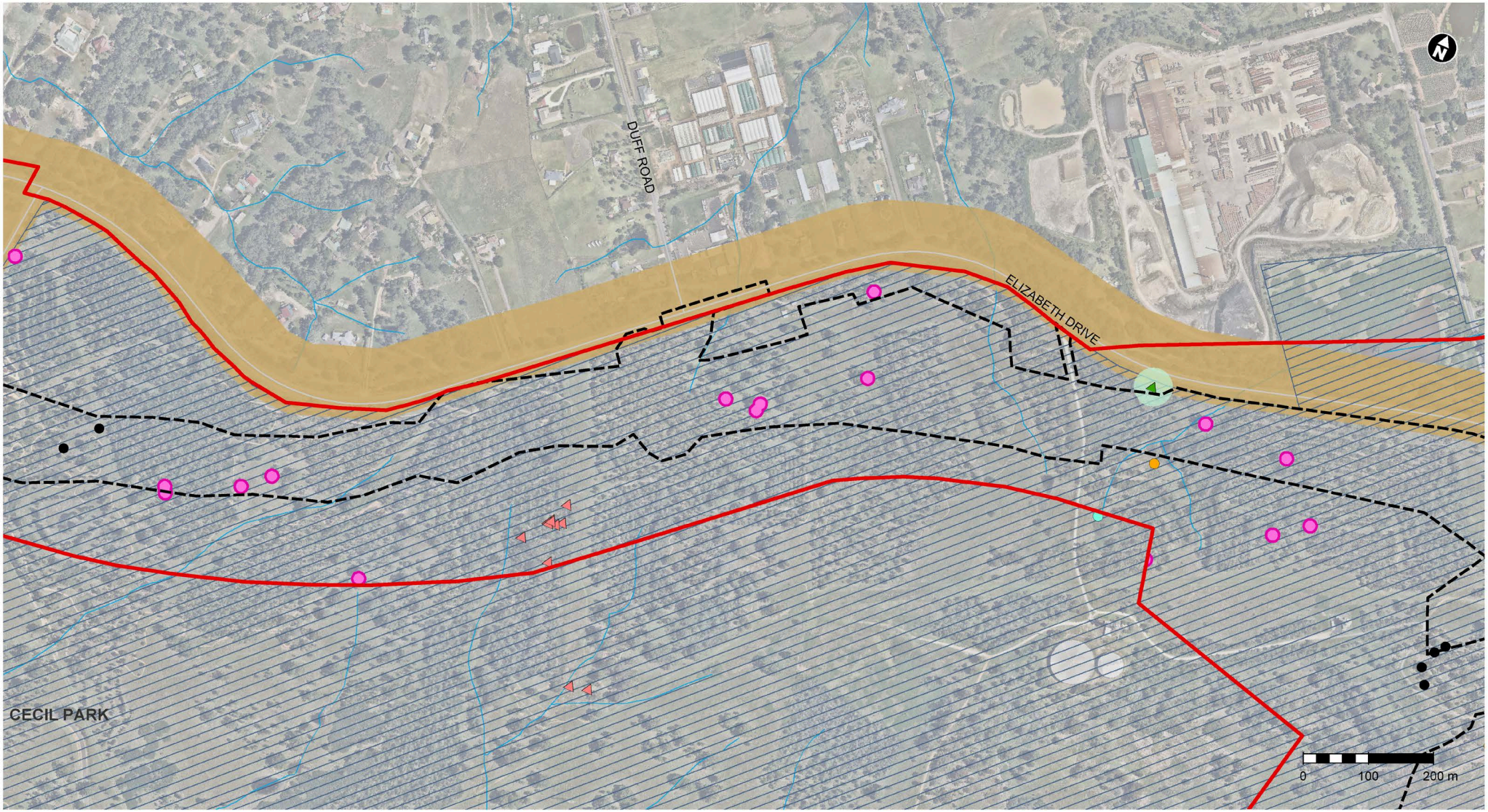

Figure 7-9 Recorded threatened species within the study area

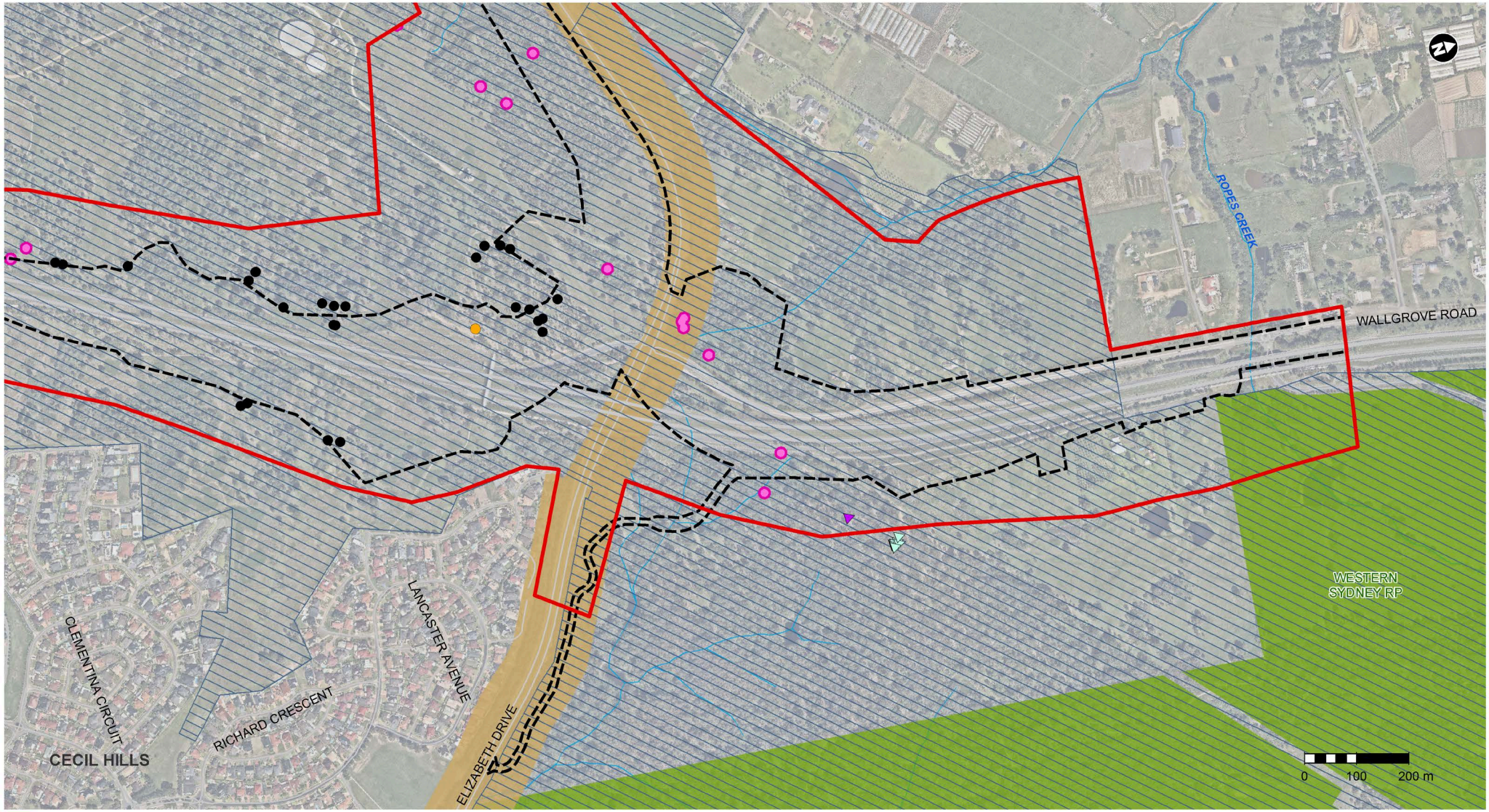

Figure 7-9 Recorded threatened species within the study area

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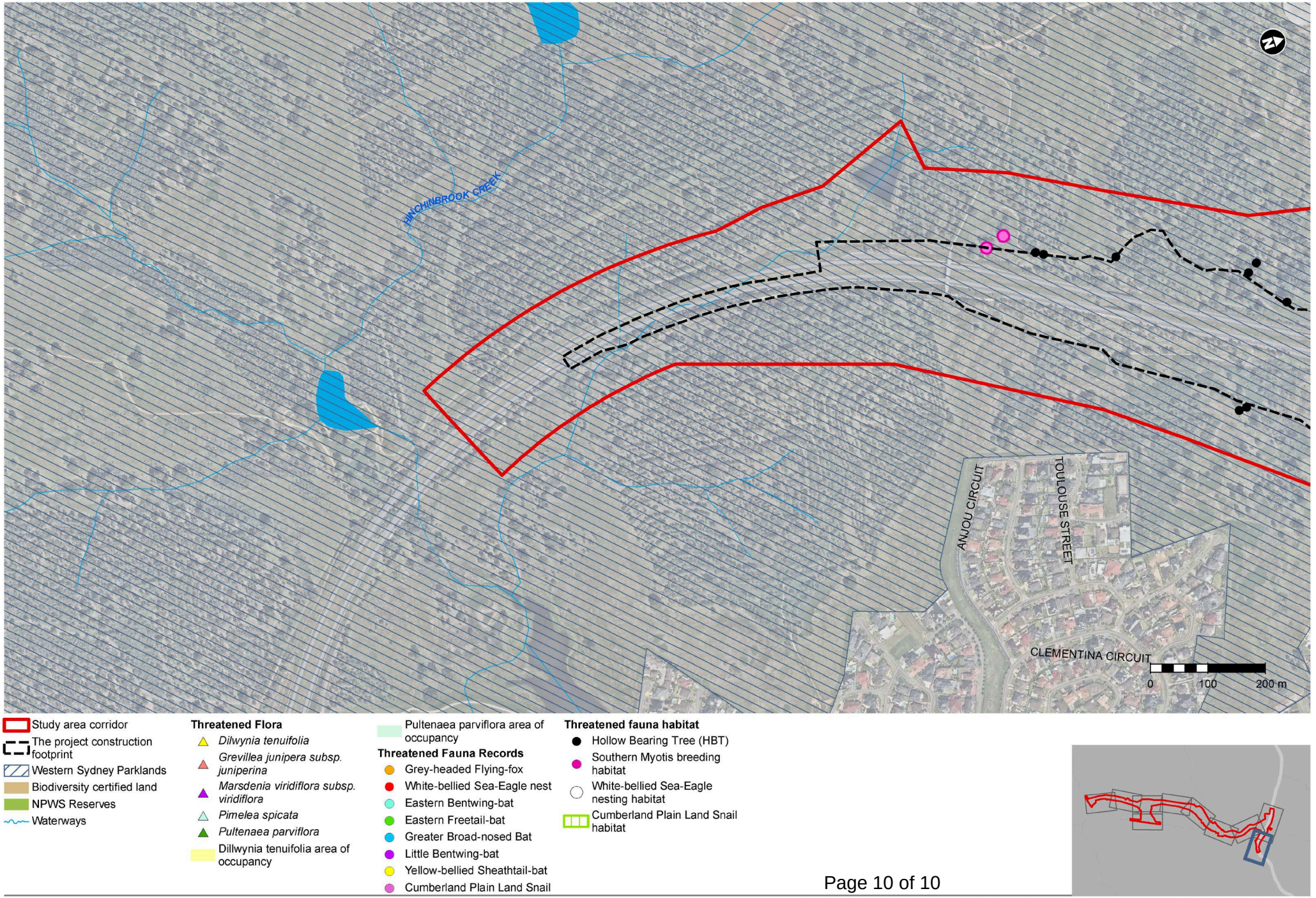

Figure 7-9 Recorded threatened species within the study area

Table 7-11 Threatened flora species recorded within the study area and construction footprint

Threatened flora species	Status		Number of plants recorded in the study area	Number of plants recorded within the construction footprint (outside of certified areas)	Approximate distance (m) of closest record from construction footprint
	TSC Act	EPBC Act			
Dillwynia tenuifolia	V	-	464	244	N/A
Grevillea juniperina subsp. juniperina	V	-	32	0	90
Marsdenia viridiflora subsp. viridiflora in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith Local Government Areas	EP	-	3	0	70
Pimelea spicata	E	E	0[1]	0	70
Pultenaea parviflora	E	V	278	90	N/A

E = Endangered, EP = Endangered Population, V = Vulnerable
[1] (recorded 15 metres east of study area)

Weeds

Seventy-three exotic species were identified in the study area. Eleven of these are declared as Priority Weeds for the Greater Sydney region under the *Biosecurity Act 2015*. Of these species, nine are also included on the Commonwealth list of 32 Weeds of National Significance (WoNS). Nineteen additional exotic species recorded in the study area are considered by EESG to be high threat weeds (DoEE, 2019). High threat weeds and WoNS recorded in the study area are listed in **Table 7-12**, overleaf.

Terrestrial fauna

Fauna habitat

Vegetation communities within the study area were consolidated into four broader fauna habitat types based on general similarities in vegetation type, geology, landscape setting, habitat connectivity and fauna habitat values. A summary of the four fauna habitat types is provided in **Table 7-13**, overleaf.

Field surveys also recorded 94 hollow-bearing live trees and stags. The location of hollow-bearing trees is provided in **Figure 7-9**.

Threatened fauna species

Thirty-two threatened fauna species were identified as having a moderate to high likelihood to occur within the study area and were targeted during survey. Seven threatened fauna species were recorded within the study area during surveys and a further three species are assumed to be present (Cumberland Plain Land Snail, Southern Myotis and Eastern False Pipistrelle).

The Cumberland Plain Land Snail was not recorded within the study area during surveys but was recorded 135 metres from the study area during surveys for a separate project in October 2018. Given the connectivity and similarity of habitat, the Cumberland Plain Land Snail is therefore assumed to be present within the study area in all riparian forest habitat along Badgerys Creek.

‘Possible’ calls of Southern Myotis and Eastern False Pipistrelle were recorded during surveys. These two microbat species cannot be confidently discounted based on the results of surveys and are therefore assumed to be present within the study area, within suitable habitat.

Table 7-12 High threat weeds and WoNS within the study area

Scientific name	Common name	WoNS	High threat weed
Alternanthera philoxeroides	Alligator weed	Yes	Yes
Anredera cordifolia	Madeira-vine	Yes	Yes
Acetosa sagittata	Turkey rhubarb	No	Yes
Acetosella vulgaris	Red sorrel	No	Yes
Ageratina adenophora	Crofton weed	No	Yes
Araujia sericifera	-	No	Yes
Asparagus asparagoides	Bridal creeper	Yes	Yes
Axonopus fissifolius	Carpet grass	No	Yes
Bidens pilosa	Beggar's tick	No	Yes
Briza subaristata	-	No	Yes
Cardiospermum grandiflorum	Balloon vine	No	Yes
Cestrum parqui	Green cestrum	No	Yes
Chloris gayana	Rhodes grass	No	Yes
Cyperus eragrostis	Tall flatsedge	No	Yes
Ehrharta erecta	Panic veldtgrass	No	Yes
Eragrostis curvula	Weeping lovegrass	No	Yes
Hypericum perforatum	St John's-wort	No	Yes
Juncus acutus	Spiny Rush	No	Yes
Lantana camara	West Indian Lantana	Yes	Yes
Ligustrum lucidum	Glossy privet	No	Yes
Ligustrum sinense	Chinese privet	No	Yes
Lycium ferocissimum	African boxthorn	Yes	Yes
Nassella neesiana	Chilean needlegrass	Yes	Yes
Olea europaea subsp. cuspidata	Wild olive	No	Yes
Opuntia stricta	Prickly pear	Yes	Yes
Paspalum dilatatum	Dallisgrass	No	Yes
Romulea rosea	Onion grass	No	Yes
Rubus fruticosus (sp. agg)	Blackberry	Yes	Yes
Senecio madagascariensis	Madagascar ragwort	Yes	Yes
Tradescantia fluminensis	Small-lead spiderwort	No	Yes

Table 7-13 Summary of fauna habitat types within study area

Fauna habitat type	Equivalent PCTs	Area within study area (ha)	Description
Woodland habitat	724, 725, 830, 849, 850 (except the low condition derived native grassland) and 883	160.44	Dense understorey grasses, coarse woody debris and leaf litter provide shelter habitat for small terrestrial amphibians and reptiles Large living or dead hollow-bearing trees are relatively scarce. Canopy trees in woodland habitat provide blossom resources for common nectivorous birds, small gliders and flying-foxes.
Riparian forest	835 and 1800	36.70	This habitat typically occurs as linear strips of native vegetation surrounded by largely cleared grazing land. Wider patches of riparian forest (eg along some sections of Kemps Creek and Badgerys Creek) support large mature Eucalyptus trees (some with small or medium sized hollows) and dense understorey vegetation able to support hollow-dependent fauna.
Grassland	Derived grassland PCT 850 in low condition	684.54	This habitat is comprised almost entirely of land cleared of native forest or woodland for grazing, cropping and more recently for residential and industrial development. Large scattered paddock trees and stags occur within grassland habitat in some sections of the study area, some supporting small, medium and large hollows. Hollows within the grasslands of the study area are likely to provide roosting habitat for common, adaptable microbats and were observed to provide nesting habitat for bird species including Little Corella, Long-billed Corella, Eastern Rosella and Red-rumped Parrot. Native fauna most frequently recorded from grassland habitat during surveys were highly adaptable species typically associated with cleared landscapes.
Wetlands and watercourses	N/A	11.98	Most dams are located within cleared grazing lands and provide limited habitat value for most wetland-dependent fauna (eg Australasian Bittern). Some of these dams support emergent and/or submerged aquatic vegetation. Very few provide dense bankside vegetation and/or shelter habitat such as rocks and coarse woody debris. Dams may provide a water resource for woodland fauna such as birds, macropods and microbats. Most watercourses within the study area were heavily altered by earthworks, construction, pollution, vegetation clearing, erosion and sedimentation. Further detail regarding the watercourses and aquatic habitat present within the study area is provided in ‘Aquatic habitat’ below.

The threatened species recorded or assumed to be present are listed in **Table 7-14.** Recorded locations of threatened species are shown in **Figure 7-9**.

Two threatened fauna species were identified as species credit species and nine species are ecosystem credit species. The Southern Myotis is a dual ecosystem/species credit species (as explained in **Section 7.1.2** under 'Offsetting required').

Migratory species

The Protected Matters Search Tool (PMST) report identified 16 listed migratory species with the potential to occur within 10 kilometres of the study area. Preliminary desktop assessments identified eight of the 16 species to have a moderate likelihood of occurrence and eight to have a low likelihood of occurrence in the study area. Subsequent habitat assessments and field surveys assessed that all 16 species have a low likelihood of occurrence in the study area.

The White-bellied Sea-Eagle, which was observed roosting in the study area (see **Table 7-14**) is not considered a migratory species.

Threatened aquatic species

No potential habitat for threatened fish listed under the FM Act and EPBC Act occurs within the study area Therefore, no threatened fish species are anticipated to occur within the study area.

Aquatic habitat

Following the aquatic habitat assessment, the following sites were considered sensitive receiving environments:

- Cosgroves Creek
- Badgerys Creek
- South Creek
- Kemps Creek
- Unnamed tributary of Hinchinbrook Creek
- Doujon Lake
- Hinchinbrook Creek
- Hinchinbrook Creek downstream of SEPP Coastal Wetland.

The details of each aquatic survey point are summarised in **Table 7-15**. The location of key fish habitat is provided in **Figure 7-10**.

A search of RIAR Spatial Data Portal found none of the waterways within the study area contain mapped habitat for threatened fish listed under the FM Act, based on predicted occupancy extents.

A full description of aquatic habitat at each survey point is provided in **Appendix E**.

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are ecological communities that are dependent, either entirely or in part, on the presence of groundwater for their health or survival.

A search of the Bureau of Meteorology's GDE Atlas indicated that there are several locations within the study area that have a moderate to high potential to depend on groundwater within the study area. South Creek is considered to have a high potential to support aquatic GDE, while moderate to high potential GDEs were also mapped within the study area, generally near the four creek crossings (Cosgroves, Badgerys, South and Kemps Creeks).

Table 7-14 Threatened fauna species recorded or assumed to occur within the study area and construction footprint

Threatened fauna species	Scientific name	Status		Recorded or assumed	Ecosystem or species credit species	Can the species withstand further loss?	Habitat feature/ component	Habitat present within study area	Habitat present within construction footprint (outside of certified areas)
		TSC Act	EPBC Act						
Cumberland Plain Land Snail	*Meridolum corneovirens*	E	-	Assumed	Species	Yes	All riparian forest fauna habitat along Badgerys Creek within the study area.	6.00 ha	1.86 ha
Southern Myotis (breeding)	*Myotis macropus*	V	-	Assumed. Potential breeding habitat recorded	Species	Yes	Hollow-bearing trees within 200 metres of riparian zones	1.54 ha (area surrounding 52 hollow-bearing trees)	0.92 ha (area surrounding 35 hollow-bearing trees)
Southern Myotis (forage habitat)				Assumed	Ecosystem	Yes	Wetland and waterways (foraging)	11.98 ha (foraging)	3.69 ha (foraging)
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	V	-	Recorded	Ecosystem	No	Nest site (breeding) Wetland and waterways (foraging)	1 nest (breeding) 11.98 ha (foraging)	1 nest (breeding) 3.69 ha (foraging)
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V	-	Recorded	Ecosystem	Yes	PCT 724, PCT 830, PCT 835, PCT 849, PCT 850, PCT 1800	197.14 ha	55.58 ha
Eastern Freetail-bat	*Mormopterus norfolkensis*	V	-	Recorded	Ecosystem	Yes			

Threatened fauna species	Scientific name	Status		Recorded or assumed	Ecosystem or species credit species	Can the species withstand further loss?	Habitat feature/ component	Habitat present within study area	Habitat present within construction footprint (outside of certified areas)
		TSC Act	EPBC Act						
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	-	Recorded	Ecosystem	Yes			
Eastern Bentwing-bat (forage habitat)	*Miniopterus schreibersii oceanensis*	V	-	Recorded	Ecosystem	Yes			
Little Bentwing-bat (forage habitat)	*Miniopterus australis*	V	-	Recorded	Ecosystem	No			
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	V	-	Assumed	Ecosystem	Yes			
Grey-headed Flying-fox (foraging habitat)	*Pteropus poliocephalus*	V	V	Recorded	Ecosystem	No	PCT 724, PCT 830, PCT 835, PCT 849, PCT 850, PCT 1800 No camps (roosting, breeding) occur within the study area.	195.71 ha	55.20 ha

E = Endangered, V = Vulnerable

Table 7-15 Aquatic habitat values for each waterway within the study area

Survey point	Waterway name	Stream order	Waterway class	Key fish habitat	Aquatic survey - Habitat description
AQ1	Unnamed tributary of South Creek	1st	4 – unlikely fish habitat	Not mapped as key fish habitat. This was verified and confirmed during field assessments.	An ephemeral stream which was dry at the time of inspection. The channel is narrow, averaging one metre wide. The substrate is a silty clay, and no evidence of active erosion was observed during site inspections. No instream aquatic habitat was present. Threatened fish are not predicted to occur (DPI, 2018). The riparian habitat is largely cleared for grazing. The water-dependent EEC Swamp Oak Floodplain Forest occurs within the riparian corridor of this waterway. The unnamed tributary of South Creek was not identified as a sensitive receiving environment.
AQ2	Cosgroves Creek	4th	2 – moderate fish habitat	Key fish habitat (Type 2) - moderately sensitive key fish habitat. The creek is also currently mapped by DPI as key fish habitat (DPI, 2018).	An ephemeral stream, which was mostly dry at the time of inspection. A shallow residual pool was located upstream at the site. The average channel width was five metres consisting of a silty clay substrate. Active erosion and undercutting occurred along the banks, particularly within channel meanders, suggesting a high potential for erosion at this site. A variety of aquatic habitat is present, with woody snags greater than three metres and the aquatic macrophyte Typha orientalis present throughout the site. Threatened fish are not predicted to occur. However, the water dependent EEC Swamp Oak Floodplain Forest is within the riparian corridor. Cosgroves Creek was identified as a sensitive receiving environment as it was identified as Type 2 key fish habitat. However, it is unlikely to be sensitive to the project operation due to its ephemeral nature and impacted upstream catchment.
AQ3	Unnamed tributary of Cosgroves Creek	2nd	4 – unlikely fish habitat	Not mapped as key fish habitat. This was verified and confirmed during field assessments.	An ephemeral drainage line which was dry at the time of inspection. There was limited channel definition, consisting of a grassed depression between two farm dams. The channel consists of a sandy clay substrate with no areas of active erosion. No aquatic habitat was present, and threatened fish are unlikely to occur (DPI, 2018). The unnamed tributary of Cosgroves Creek was not identified as a sensitive receiving environment.

Survey point	Waterway name	Stream order	Waterway class	Key fish habitat	Aquatic survey - Habitat description
AQ4	Unnamed tributary of Badgerys Creek	3rd	4 – unlikely fish habitat	Not mapped as key fish habitat. This was verified and confirmed during field assessments.	An ephemeral stream which was dry at the time of inspection. The creek has limited channel definition and has not received flows for some time as evidenced by the poor condition Typha orientalis and encroaching terrestrial vegetation. The silty clay channel shows no evidence of active erosion. A large tree has fallen over within the reach, but is unlikely to provide aquatic habitat due to low and shallow flows the site receives. Threatened fish are not predicted to occur (DPI, 2018). The unnamed tributary of Badgerys Creek was not identified as a sensitive receiving environment.
AQ5	Badgerys Creek	4th	2 – moderate fish habitat	Key fish habitat (Type 2) - moderately sensitive key fish habitat. The creek is also currently mapped by DPI as key fish habitat (DPI, 2018).	An ephemeral stream which was dry at the time of inspection. The average channel width was five metres and consisted of a silty clay substrate. Active erosion and undercutting occurred along the banks, particularly within channel meanders, suggesting a high potential for erosion at this site. Abundant woody snags greater than three metres were present, however there were no aquatic macrophytes. Threatened fish are not predicted to occur (DPI, 2018). However, the water dependent EEC, River Flat Eucalypt Forest occurs within the riparian corridor. Badgerys Creek was identified as a sensitive receiving environment as it is Type 2 key fish habitat. However, it is unlikely to be sensitive to the project's operation due to its ephemeral nature and impacted upstream catchment.
AQ6	South Creek	4th	2 – moderate fish habitat	Key fish habitat (Type 1) - highly sensitive key fish habitat. The creek is also currently mapped by DPI as key fish habitat (DPI, 2018).	Low flows were observed at the time of inspection. The creek consisted of a series of large, disconnected residual pools about seven metres wide. The water level was very low, with a green algae bloom present on the water's surface. Silty clay substrate with active erosion and undercutting along the banks suggesting a high potential for erosion at this site given the limited riparian habitat present. Abundant woody snags greater than three metres are present, however there are no instream aquatic macrophytes. Threatened fish are not likely to occur (DPI, 2018). However, a small area of the water dependent EEC Swamp Oak Floodplain Forest occurs within the riparian corridor. South Creek was identified as a sensitive receiving environment as it is Type 1 key fish habitat providing important residual pools for fish refuge.

Survey point	Waterway name	Stream order	Waterway class	Key fish habitat	Aquatic survey - Habitat description
AQ7	Kemps Creek	4th	2 – moderate fish habitat	Key fish habitat (Type 1) - highly sensitive key fish habitat. The creek is also currently mapped by DPI as key fish habitat (DPI, 2018).	Low flows were observed at the time of inspection. The creek consisted of shallow disconnected residual pools each about 5 metres wide. Silty clay substrate with active erosion and undercutting along the banks, particularly within the channel meanders, suggesting a moderate potential for erosion, especially if the surrounding riparian habitat is removed. A variety of aquatic habitat is present, with woody snags greater than three metres, trailing bank vegetation and the aquatic macrophyte Typha orientalis present. Threatened fish are not predicted to occur (DPI, 2018). However, the water-dependent EEC Swamp Oak Floodplain Forest occurs within the riparian corridor. Kemps Creek was identified as a sensitive receiving environment as it is Type 1 key fish habitat providing important residual pools for fish refuge.
AQ8	Unnamed tributary of Kemps Creek	3rd	4 – unlikely fish habitat	The creek is classified as key fish habitat based on DPI mapping (DPI, 2018). However, field assessments found that the waterway had limited aquatic habitat, and therefore this waterway was identified as key fish habitat (DPI, 2013).	An ephemeral waterway which was dry at the time of inspection. The channel is narrow, averaging less than one metre wide and is filled with the aquatic macrophyte Typha orientalis. The substrate is a silty clay, and no evidence of active erosion was observed. Given the limited aquatic habitat and water present at the downstream site, the upstream site is unlikely to contain water and is not considered to be a sensitive receiving environment.
AQ9	Ropes Creek	1st	4 – unlikely fish habitat	Not mapped as key fish habitat. Within the construction and operational footprint Ropes Creek is not mapped as key fish habitat, however about 600 metres downstream the creek becomes mapped as key fish habitat (DPI, 2018).	Ropes Creek is an ephemeral waterway which was dry at the time of inspection. There is minimal channel definition, with the downstream extents dominated by a weedy vegetation. The substrate is a silty clay, and no evidence of active erosion was observed during site inspections. No instream aquatic habitat was present, with no instream woody debris or residual pools. However, some aquatic macrophytes may be present in the densely vegetated channel. Threatened fish are not predicted to occur (DPI, 2018). Ropes Creek was not identified as a sensitive receiving environment

Survey point	Waterway name	Stream order	Waterway class	Key fish habitat	Aquatic survey - Habitat description
AQ10	Unnamed tributary of Ropes Creek	1st	4 – unlikely fish habitat	The creek is classified as key fish habitat based on DPI mapping (DPI, 2018). However, field assessments found that the waterway had limited aquatic habitat, and therefore this was waterway has not been identified as key fish habitat (DPI, 2013).	The unnamed tributary of Ropes Creek is a first order ephemeral drainage line with limited channel definition. No water was present at the time of inspection. No aquatic habitat was present, and the drainage line is dominated by terrestrial weeds (blackberry). Threatened fish are not likely to occur (DPI, 2018). The unnamed tributary of Ropes Creek was not identified as a sensitive receiving environment.
AQ11	Unnamed tributary of Hinchinbrook Creek	2nd	3 – minimal fish habitat	Key fish habitat (Type 3) – minimally sensitive key fish habitat. The creek is also mapped by DPI as key fish habitat (DPI, 2018).	The channel had been dry for some time when surveyed, dominated by Juncus sp. and with exotic grasses encroaching the channel bed. Threatened fish are not predicted to occur (DPI, 2018). About 1.5 kilometres downstream is a Coastal Wetland listed under the Coastal Management SEPP. As such, the site was identified as a sensitive receiving environment.
AQ12	Doujon Lake	N/A (Lake)	2 – moderate fish habitat	Key fish habitat (Type 2) – moderate sensitive key fish habitat. Provides fish refuge and a variety of aquatic habitats (DPI, 2013).	Doujon Lake is located upstream of a SEPP Coastal Wetland (within 500 metres). A variety of aquatic habitat was present including overhanging vegetation, undercut banks and a small patch of aquatic macrophytes (Phragmites australis). Doujon Lake is considered a sensitive receiving environment as it is directly upstream of a Coastal Wetland.

Survey point	Waterway name	Stream order	Waterway class	Key fish habitat	Aquatic survey - Habitat description
AQ13	Hinchinbrook Creek	4th	2 – moderate fish habitat	Key fish habitat (Type 1) – highly sensitive key fish habitat. The creek is also mapped by DPI as key fish habitat (DPI, 2018).	Hinchinbrook Creek is a fourth order stream consisting of a series of disconnected pools. This section of the creek contains a rock wall which forms a significant barrier to creek connectivity. Threatened fish are not predicted to occur, however the pools may provide refuge habitat for fish (DPI, 2013). A variety of aquatic habitat was present including aquatic macrophytes Triglochin sp., Persicaria sp. and Typha orientalis. Hinchinbrook Creek is considered a sensitive receiving environment as it contains Type 1 key fish habitat, and is located about 1.1 kilometres upstream of a SEPP Coastal Wetland.
AQ14	Hinchinbrook Creek downstream of SEPP Coastal Wetland	4th	1 – key fish habitat	Key fish habitat (Type 1) – highly sensitive key fish habitat. The creek is also mapped by DPI as key fish habitat (DPI, 2018).	Hinchinbrook Creek downstream from the wetland is a fourth order stream which is made up of a series of disconnected pools. Threatened fish are not predicted to occur (DPI, 2013). A variety of aquatic habitat was present including overhanging vegetation, undercut banks and dense macrophytes.

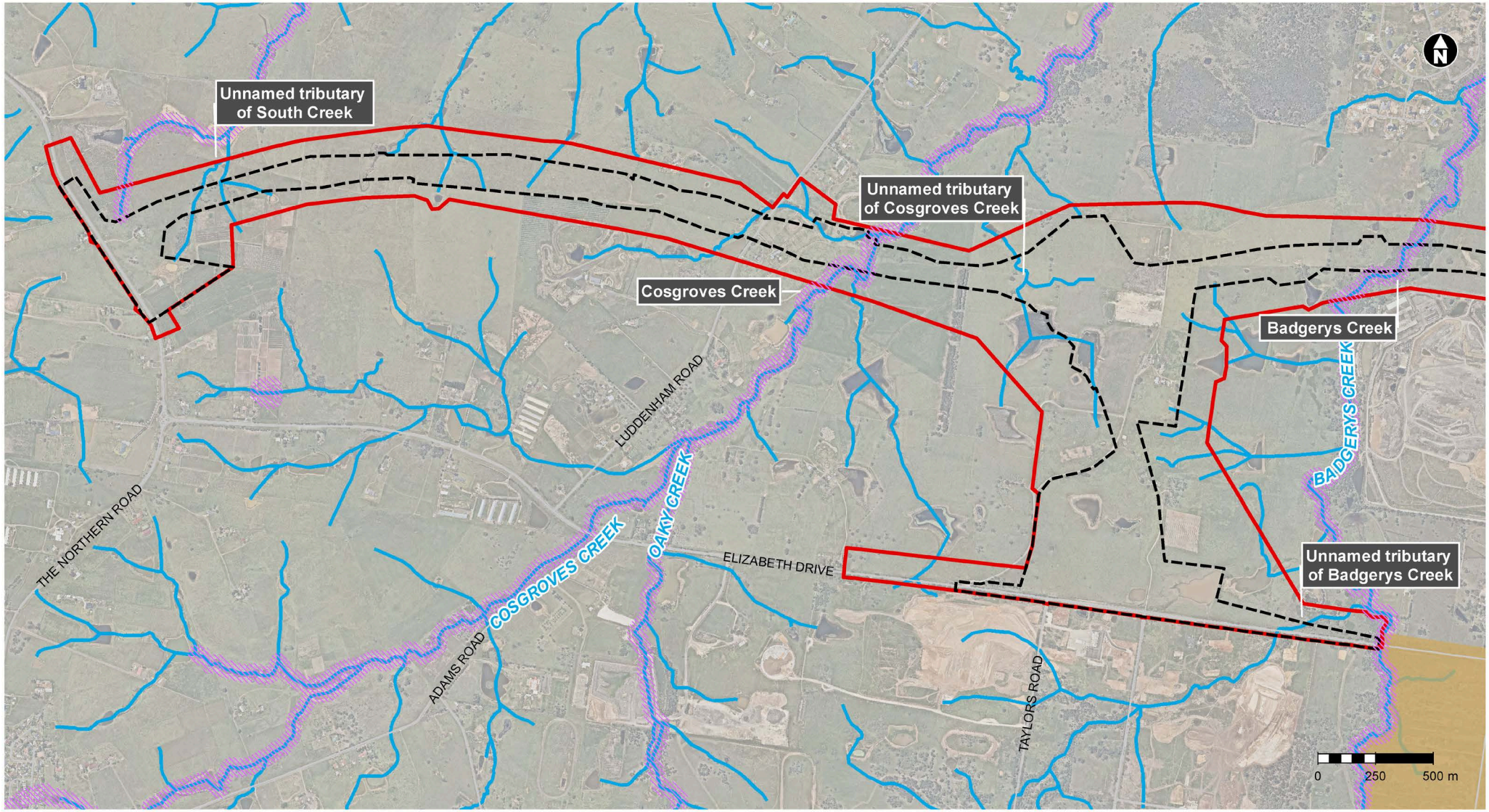

Figure 7-10 Aquatic habitat in the vicinity of the project

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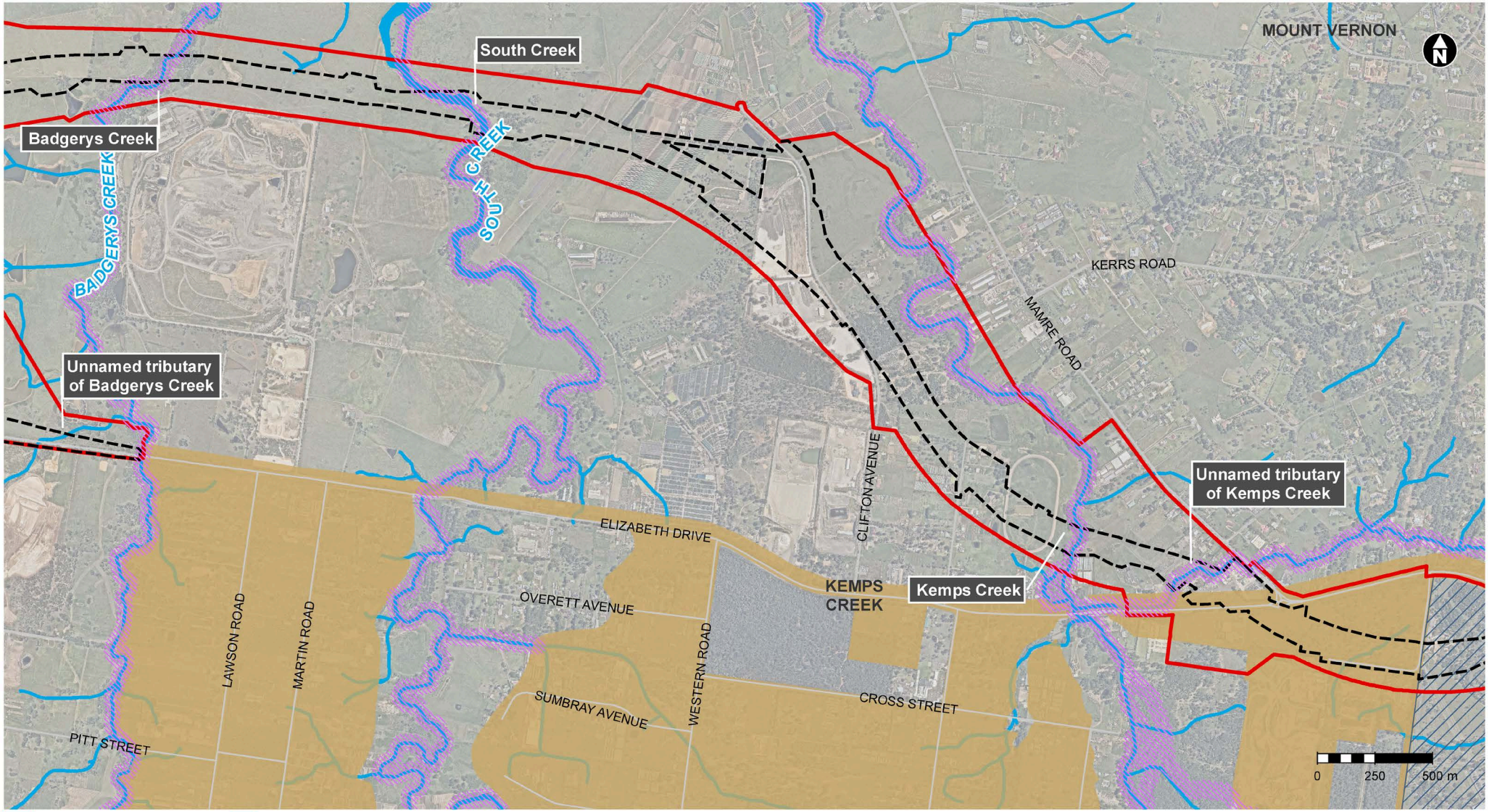

Figure 7-10 Aquatic habitat in the vicinity of the project

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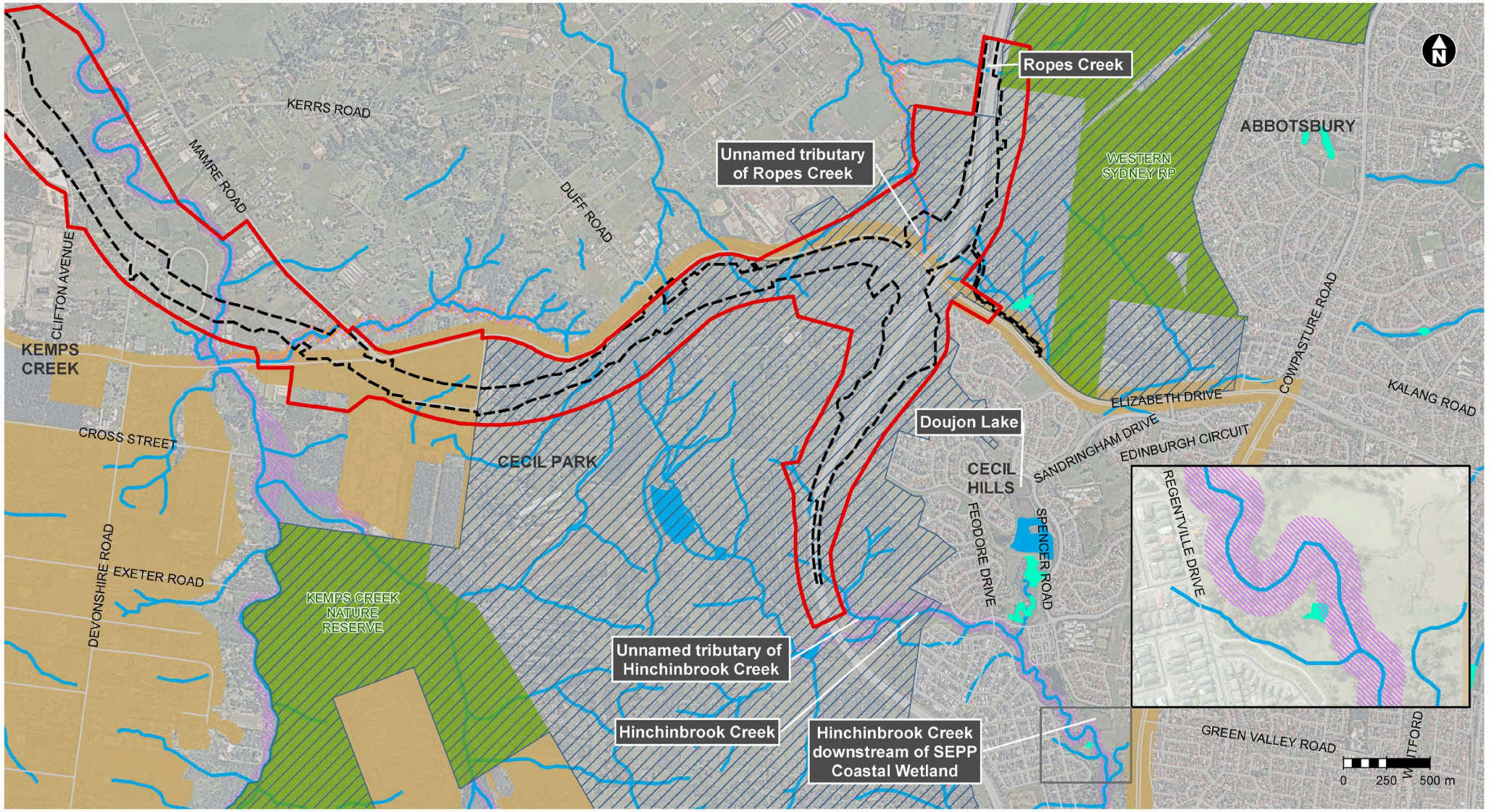

Figure 7-10 Aquatic habitat in the vicinity of the project

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The vegetation in areas that were identified as having a moderate to high potential to depend on groundwater is mapped as four PCTs:

- Swamp Oak open forests on riverflats of the Cumberland Plain and Hunter Valley (on Cosgroves Creek and Kemps Creek)
- Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion (Badgerys Creek)
- Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (eastern extent of the alignment, near the intersection with the M7 Motorway)
- Grey-Box – Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin (eastern extent of the alignment, near the intersection with the M7 Motorway).

The location of GDEs within the study area is shown in **Figure 7-11**.

7.1.4 Assessment of potential impacts

Avoidance and minimisation of impacts

Chapter 4 describes the project development and route alternatives in detail that were considered and explains how and why the project was selected as the preferred option. Further, **Chapter 4** outlines how particular elements of the project were refined. The alternative options considered in **Chapter 4** were ruled out as they did not meet the project objectives and as such there is no further consideration or comparison of potential impacts associated with these alternative options.

The FBA requires consideration of the steps taken to avoid and minimise the direct and indirect impacts of a development proposal on biodiversity values. Section 8.6.2 of the FBA sets out guidelines for the avoidance and minimisation of impacts on biodiversity during all phases of the project life cycle, including:

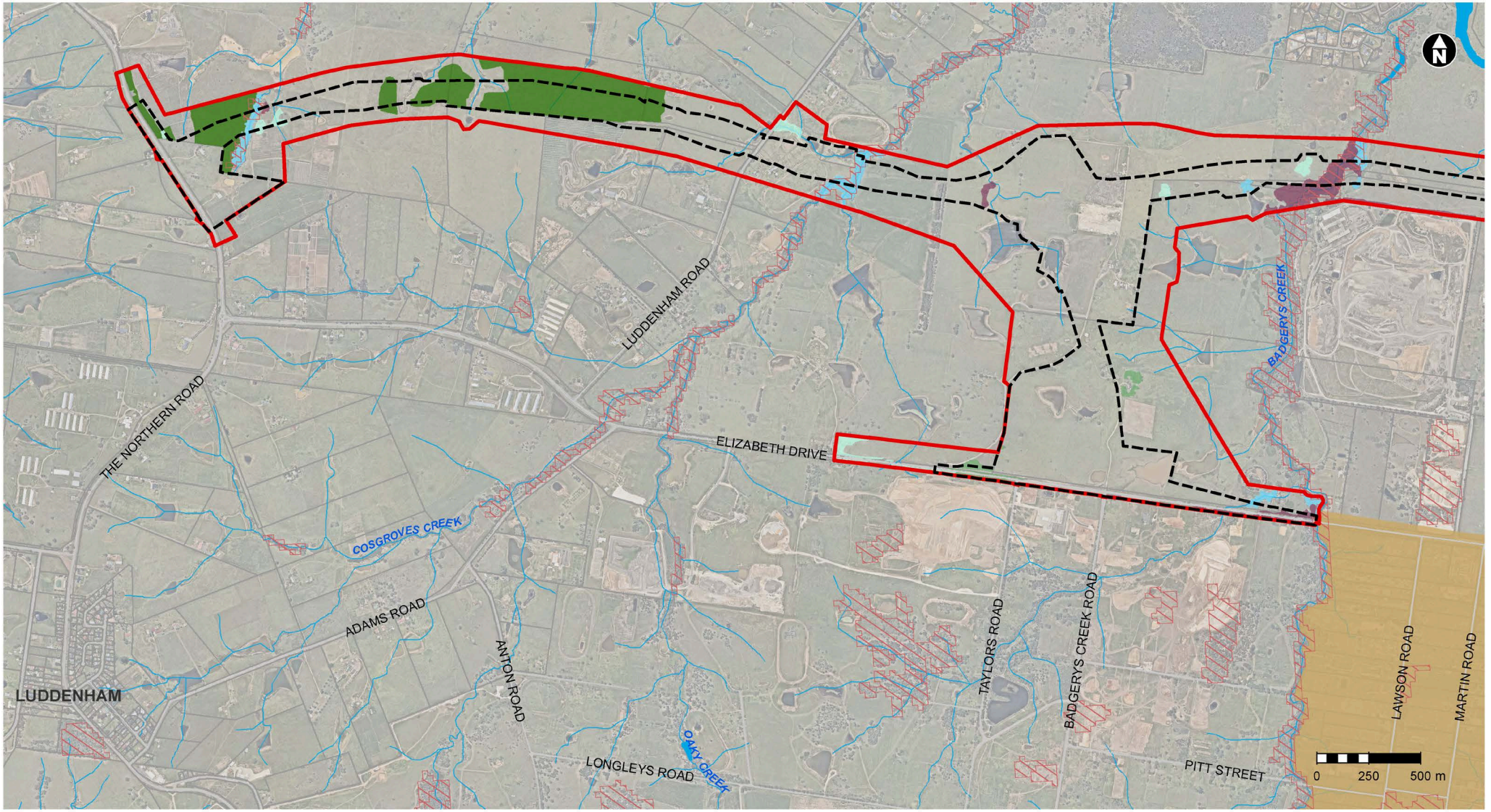
- Site selection phase
- Planning phase
- Construction phase
- Operational phase.

Biodiversity considerations informed refinement of the design throughout the site selection phase from the development of a long list of route options through to the selection of the preferred option. Where it is not possible to avoid impacts, ecological input during the remainder of the design process would focus on minimising impacts on biodiversity as far as possible, especially minimising the clearing of Cumberland Plain Woodland.

The guidelines for the avoidance and minimisation of biodiversity impacts during each of the four phases listed above, as outlined in the FBA, and the biodiversity assessment process carried out for the project, are provided in **Appendix E**.

Areas not requiring further assessment

In accordance with the FBA, certain areas and activities do not require assessment, including activities carried out within certified land (in accordance with the terms of the Biodiversity Certification Order). Therefore, the assessment of impacts within the construction footprint has excluded assessment of impacts on the certified areas.



Study area corridor
The project construction footprint
Western Sydney Parklands
Biodiversity certified land
NPWS Reserves
Cadastre
Waterways

Groundwater Dependent Ecosystems (BoM, 2018)
Surface dependent
Subsurface dependent

Plant Community Type (PCT)

- Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion [724]
- Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion [725]
- Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion [830]
- Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion [835]
- Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion [849]
- Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion [850]
- Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (derived grassland form) [850]
- Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion [883]
- Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley [1800]

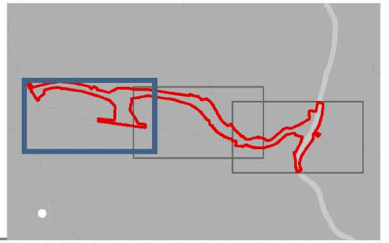


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Figure 7-11 Groundwater dependent ecosystems within the study area

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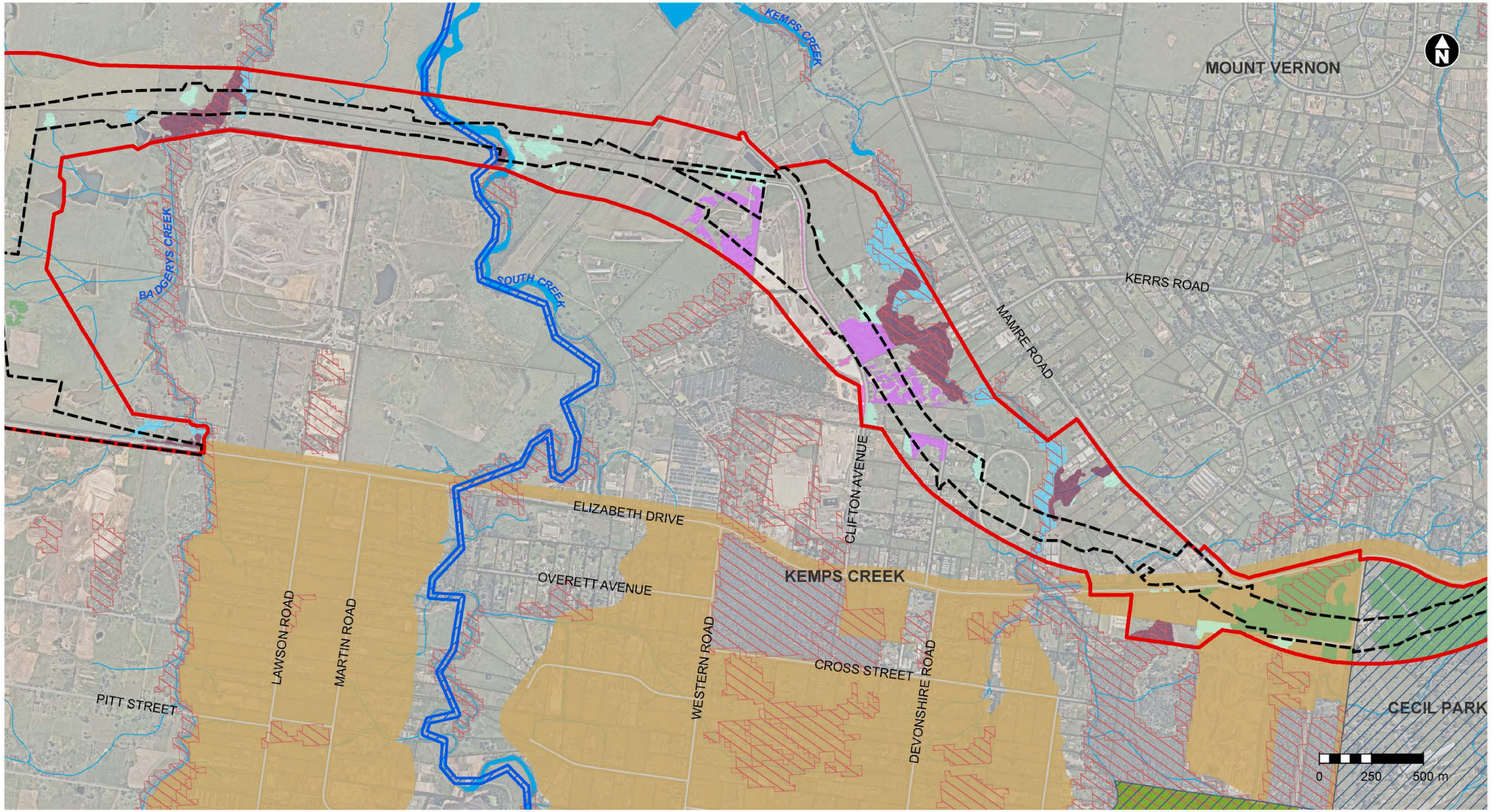

Study area corridor
The project construction footprint
Western Sydney Parklands
Biodiversity certified land
NPWS Reserves
Cadastre
Waterways

Groundwater Dependent Ecosystems (BoM, 2018)
Surface dependent
Subsurface dependent

Plant Community Type (PCT)

Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion [724]

Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion [725]

Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion [830]

Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion [835]

Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion [849]

Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion [850]

Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (derived grassland form) [850]

Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion [883]

Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley [1800]

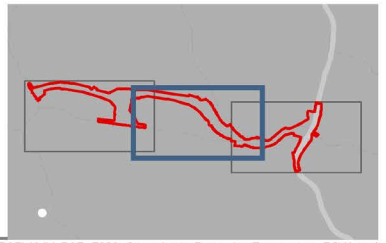

Figure 7-11 Groundwater dependent ecosystems within the study area

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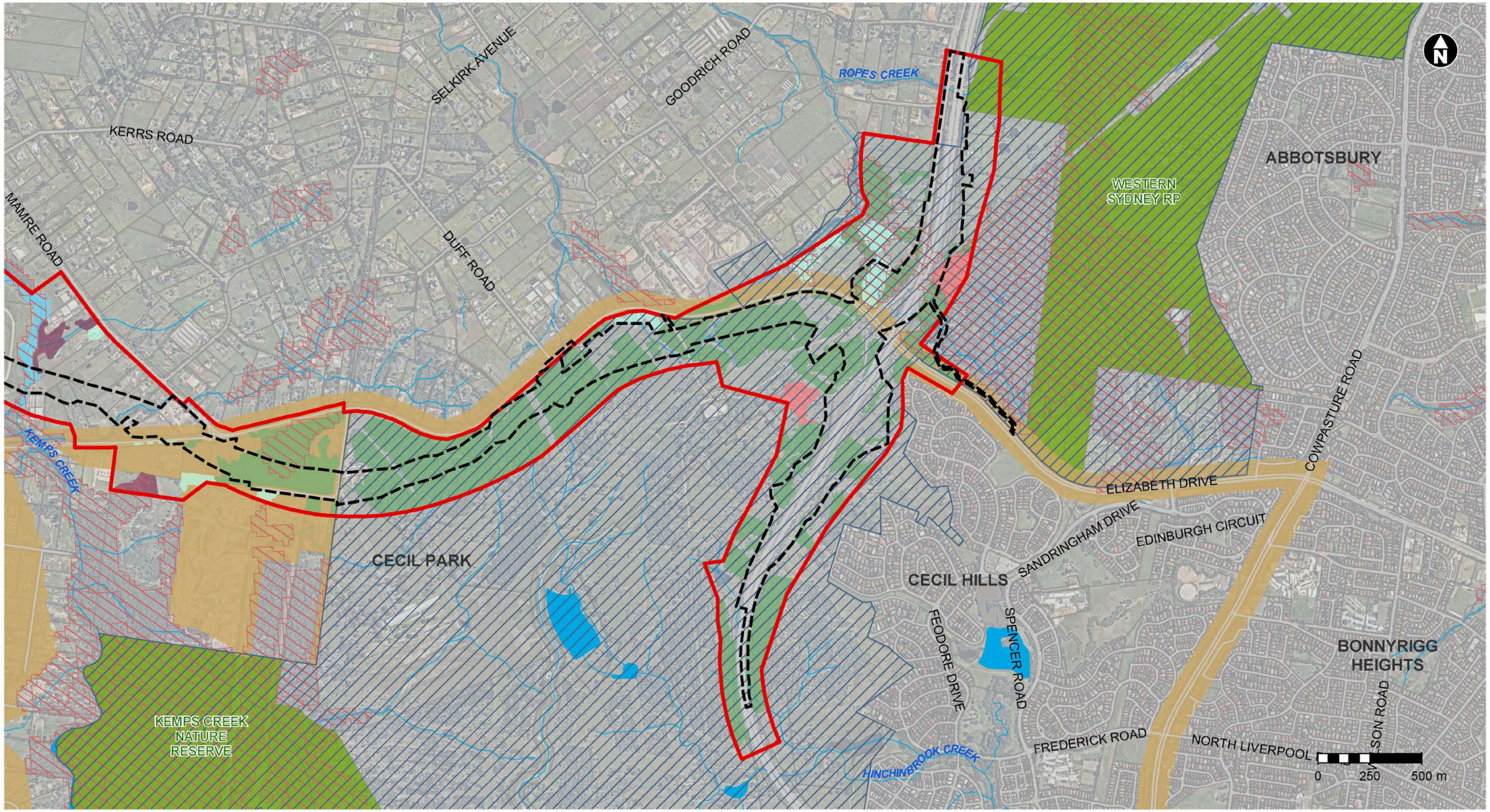

Study area corridor
The project construction footprint
Western Sydney Parklands
Biodiversity certified land
NPWS Reserves
Cadastre
Waterways

Groundwater Dependent Ecosystems (BoM, 2018)
Surface dependent
Subsurface dependent

Plant Community Type (PCT)

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- Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (derived grassland form) [850]
- Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion [883]
- Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley [1800]

Figure 7-11 Groundwater dependent ecosystems within the study area

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In accordance with the FBA, impacts on threatened species habitat associated with a PCT within a vegetation zone with a site value score of less than 17 do not require further assessment. One vegetation zone within the construction footprint, Grey Box – Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion – Low condition, was identified as having a site value score of less than 17. As such, impacts on this vegetation zone do not require assessment.

The following sections outline the project's potential construction and operational impacts on biodiversity.

Construction impacts

Removal of native vegetation

Direct impacts

Construction of the project would require the removal of 73.65 hectares of native vegetation that occurs in the construction footprint. Vegetation from seven PCTs would be removed, all of which fall within the definition of TECs. Much of this vegetation exists in small fragmented patches which were disturbed by agricultural and industrial developments and exist in varying conditions.

There are also some larger areas of remnant, regrowth and revegetated bushland in and adjoining the construction footprint, in the Western Sydney Parklands and around Clifton Avenue. The areas of each vegetation zone that would be directly impacted are listed in **Table 7-16**, overleaf.

Indirect impacts

The project would result in indirect impacts on some areas of native vegetation adjoining the construction footprint, mainly due to fragmentation of vegetation and creation of new edges, which may result in edge effects.

Edge effects occur when environmental conditions are altered (ie light levels, wind speed and temperature) and consequently can promote the growth of different vegetation types (including weeds), invasion by feral fauna, or change the behaviour of resident fauna.

Many of the areas of vegetation within and directly adjacent to the construction footprint are already subject to considerable edge effects. However, in some areas of Western Sydney Parklands and along Clifton Avenue, the construction footprint crosses through some larger patches of native vegetation in Moderate/ Good condition, including revegetated areas. Within these larger areas it is likely that the project would increase the potential for edge effects to occur.

Edge effects resulting from the formation of new edges could extend up to 30 metres into areas of adjoining native vegetation. Potential edge effects are changes to vegetation structure, increase in exotic species cover and alteration of microhabitats. The assessment of potential for edge effects, set out in **Table 7-17**, overleaf, found:

- A total of 0.31 hectares of native vegetation (including 0.30 hectares of revegetation) within Western Sydney Parklands would be subject to increased edge effects to the extent they would become unviable due to the small size of the remaining patches
- A total of 12.42 hectares of native vegetation (including 6.73 hectares of revegetation) within Western Sydney Parklands and east of Clifton Avenue would be subject to increased edge effects as a result of the project due to the creation of one or more new edges within previously unfragmented vegetation.

Table 7-16 Direct impacts on native vegetation

PCT No.	PCT name	Condition	TSC Act Status	EPBC Act Status	Area within construction footprint	Area within construction footprint (ha)[1]
724	Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	Moderate/ Good_High	E	CE	6.9.1	3.50
		Moderate/ Good_Medium				2.96
		Moderate/ Good_Poor				0.45
830	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Moderate/ Good_Poor	E	CE	0.44	0.44
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate/ Good_Poor	E	Not listed	3.23	3.23
849	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate/ Good_Medium	CE	CE	6.59	3.54
		Moderate/ Good_Poor				2.07
		Moderate/ Good_Other (Derived Shrubland)				0.48
850	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	Moderate/ Good_High	CE	CE	61.76	3.21
		Moderate/ Good_Medium				10.14
		Moderate/ Good_Other (Revegetation)				22.65
		Low				18.07
883	Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	Poor	N/A	N/A	0.38	0.38
1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Moderate/ Good_Poor	E	E	2.53	2.53
Total					**81.84**	**73.65**

[1] *Excluding certified areas*

Table 7-17 Native vegetation subject to indirect impacts (potential edge effects)

Location	PCT	Condition	Area of indirect impact (ha)
Western Sydney Parklands (Excluding certified areas)	Non-viable fragments		
	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (PCT 850)	Moderate/ Good_Medium	0.01
		Moderate/ Good_Other (Revegetation)	0.30
	New edges		
	Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (PCT 830)	Moderate/ Good_Poor	0.54
	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849)	Moderate/ Good_Medium	0.24
	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (PCT 850)	Moderate/ Good_Medium	1.06
		Moderate/ Good_Medium	3.33
		Moderate/ Good_Other (Revegetation)	6.73
	Western Sydney Parklands (Total of non-viable fragments and new edges)		12.21
East of Clifton Avenue	Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (PCT 724)	Moderate/ Good_High	0.52
	Total east of Clifton Avenue		0.52
Total indirect impacts			**12.73**

Impacts on Biobanking site

As discussed in **Section 7.1.3**, 2.89 hectares of the 32.2 hectares Biobank site (ID number 119) is located within the construction footprint. Within this 2.89 hectares, the project would directly remove 1.85 hectares of native vegetation (included in the total 73.65 hectares being removed). A further 1.52 hectares of native vegetation would be indirectly impacted.

The native vegetation within the Biobank site corresponds to Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion vegetation community.

Roads and Maritime would work with Western Sydney Parklands Trust to amend the biobanking agreement to replace the area of the site impacted by the project elsewhere within the Parklands.

Removal of threatened fauna habitat

The project would result in the removal of about 55.58 hectares of Woodland and Riparian Forest habitat, about 275.05 hectares of Grassland habitat, and about 3.69 hectares of Wetlands and Watercourses from the construction footprint, excluding certified areas.

Species credit species

As discussed in **Section 7.1.3,** two threatened fauna species were identified as species credit species; Cumberland Plain Land Snail and Southern Myotis.

About six hectares of this habitat is considered suitable habitat for the Cumberland Plain Land Snail (species credit species) and about 1.54 hectares is considered suitable breeding habitat for the Southern Myotis (dual ecosystem/species credit species). Potential impacts on species credit species are summarised in **Table 7-18**.

Table 7-18 Impacts on species credit threatened fauna

Threatened fauna species	Status		Suitable habitat within the study area (ha)	Potential area of habitat to be impacted (ha)
	TSC Act	EPBC Act		
Cumberland Plain Land Snail	Endangered	-	6.00	1.86
Southern Myotis	Vulnerable	-	1.54 (breeding)	0.92

Ecosystem credit species

The removal of about 55.58 hectares of Woodland and Riparian Forest would also remove habitat for seven 'ecosystem credit' threatened bat species including:

- Grey-headed Flying-fox (forage habitat only)
- Eastern Bentwing-bat (forage habitat only)
- Little Bentwing-bat (forage habitat only)
- Eastern Freetail-bat
- Eastern False Pipistrelle
- Greater Broad-nosed Bat
- Yellow-bellied Sheathtail-bat.

The construction footprint is anticipated to require the removal of 54 hollow-bearing trees. Hollow-bearing trees in Woodland and Riparian Forest habitats are assumed to provide roosting habitat for four threatened hollow-dependent microbats listed as ecosystem credits, including:

- Eastern Freetail-bat
- Eastern False Pipistrelle
- Greater Broad-nosed Bat
- Yellow-bellied Sheathtail-bat.

Removal of roosting and breeding resources for these species is therefore assumed as a component of ecosystem credits. No other threatened hollow-dependent fauna were recorded or assumed present within the study area.

The study area provides suitable foraging habitat (11.98 hectares) along wetlands and waterways for the Southern Myotis. The project would require the removal of about 3.69 hectares of foraging habitat.

The project may require the removal of one active White-bellied Sea-Eagle nest, listed as an ecosystem credit species. The location of this nest is provided in **Figure 7-9**.

Removal of threatened flora

The project would result in both direct and indirect impacts on two threatened plant species: *Pultenaea parviflora* and *Dillwynia tenuifolia*. Potential indirect impacts resulting from fragmentation, degradation of

the roadside habitat from edge effects and sedimentation may result in the further loss of individuals, as described in the sections below.

The number of individuals likely to be impacted as a result of the project are outlined in **Table 7-19.** The direct impacts on *Dillwynia tenuifolia* and *Pultenaea parviflora* are shown in **Figure 7-12**.

Table 7-19 Summary of threatened flora species impacts

Threatened species	Status		Can the species withstand further loss?	Individuals in the study area	Individuals directly impacted	Individuals indirectly impacted
	TSC Act	EPBC Act				
Dillwynia tenuifolia	V	-	No	464	244	49
Grevillea juniperina subsp. juniperina	V	-	No	32	0	0
Marsdenia viridiflora subsp. *viridiflora* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith Local Government Areas	EP	-	No	3	0	0
Pimelea spicata	E	E	No	0 (recorded 15 metres east of study area)	0	0
Pultenaea parviflora	E	V	No	278	90	0

Matters for further consideration

The project would result in two types of impact that require further consideration under the FBA:

- Impacts that would substantially reduce the width of vegetation in the riparian buffer zone bordering rivers and streams fourth order or greater
- Any impact on a CEEC (unless specifically excluded in the SEARs).

These impacts are discussed in the following sections.

Impacts on riparian corridors

The project would result in impacts on the riparian buffers of the following four creeks that are fourth order streams according to the Strahler (1952) classification system:

- Cosgroves Creek
- Badgerys Creek
- South Creek
- Kemps Creek.

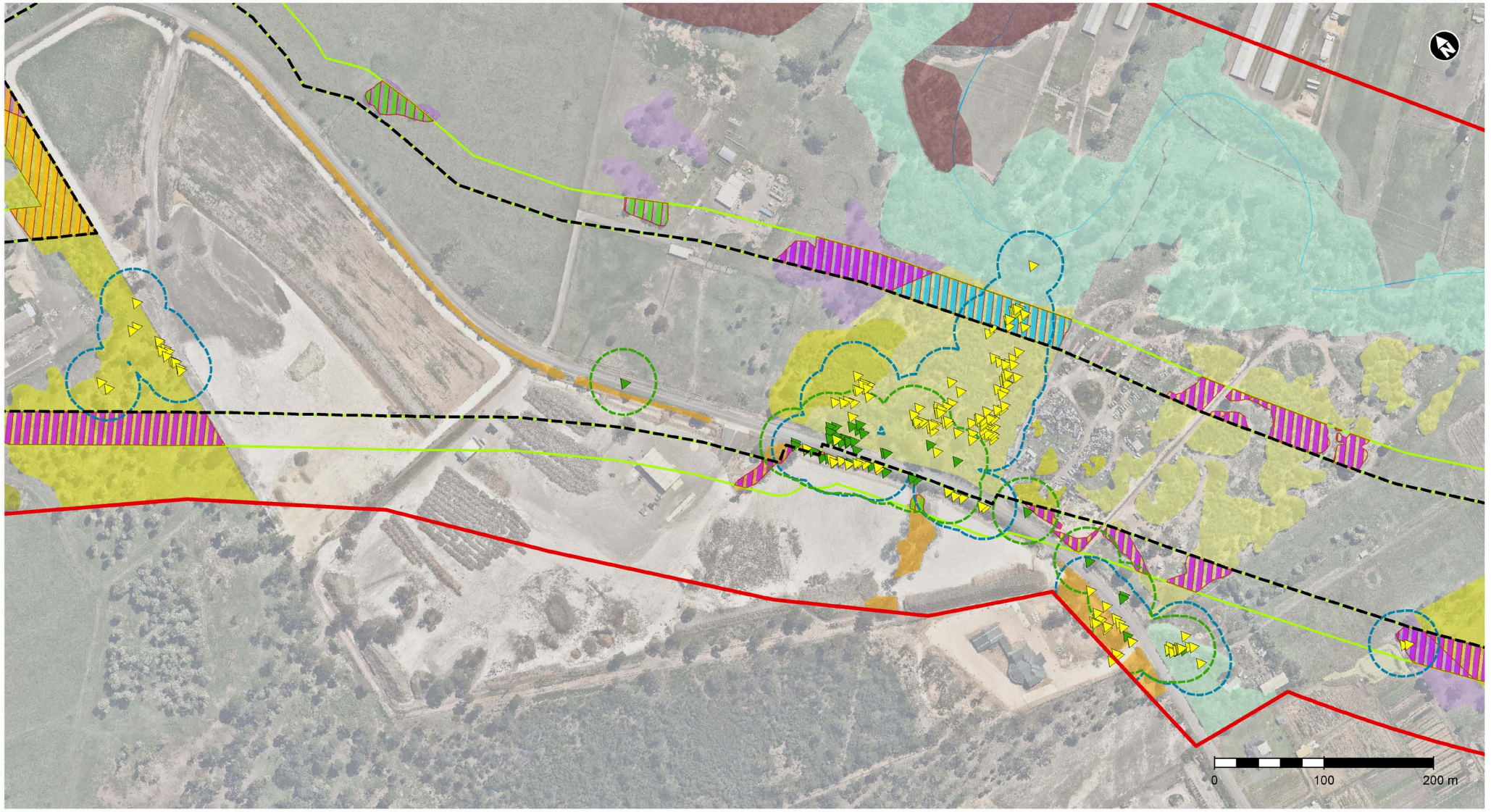

Figure 7-12 Direct and indirect impacts on threatened flora species

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Complete removal of the riparian vegetation would occur at each of these four creeks for the construction of bridges resulting in gaps of up to 110 metres long along the riparian corridors. There is an existing gap in riparian vegetation along South Creek from the northern extent of the construction footprint for a length over two kilometres along both sides of the watercourse. The project would expand this gap by about 70 metres.

About 3.32 hectares of riparian vegetation would be removed in total from riparian zones of the four creeks. The impacts on riparian vegetation at each creek, including the resulting gap due to clearing for construction is summarised in **Table 7-20**.

Fish passage would be maintained throughout the construction period. Creek adjustments, changes to hydrology and shading from construction of bridges at the four creek crossings with potential fish habitat could impact fish movement/behaviour. Impacts are likely to be minor/negligible due to the small scale of change.

Table 7-20 Impacts on riparian corridors of fourth order streams

Waterway	PCTs impacted	Vegetation condition	Total area of impact (ha)	Length of gap in riparian vegetation
Badgerys Creek	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good – Poor	1.3	110 m
	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Moderate/Good – Poor	0.05	
Kemps Creek	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Moderate/Good – Poor	0.58	110 m
	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good – Poor	0.04	
South Creek	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Moderate/Good – Poor	0.05	70 m expansion of existing 2 km gap
	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good – Poor	0.16	
	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	Moderate/Good – Moderate	0.33	
Cosgroves Creek	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Moderate/Good – Poor	0.81	105 m
Total			**3.32**	

Impacts on CEEC listed under the TSC Act

The project would have impacts on one critically endangered ecological community (CEEC) listed under the TSC Act: Cumberland Plain Woodland in the Sydney Basin Bioregion. Of the 73.65 hectares of native vegetation to be removed (corresponding with PCTs), a total of about 60.16 hectares (PCT 849, PCT 850) corresponds with Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC listed under the TSC Act (see **Table 7-21**).

Table 7-21 Impacts on CEEC listed under the TSC Act

PCT corresponding with Cumberland Plain Woodland in the Sydney Basin Bioregion	Condition	Area to be directly impacted (excluding certified areas)	Area to be indirectly impacted (excluding certified areas)
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (PCT 849)	Moderate/Good_Medium	3.54	0.24
	Moderate/Good_Poor	2.07	-
	Moderate/Good_Other (Derived Shrubland)	0.48	-
Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion (PCT 850)	Moderate/Good_High	3.21	1.07
	Moderate/Good_Medium	10.14	3.33
	Moderate/Good_Other (Revegetation)	22.65	7.03
	Low (Derived Native Grassland)	18.07	-
Total area of Cumberland Plain Woodland in the Sydney Basin Bioregion to be impacted (excluding certified areas		60.16	11.67
Total area of Cumberland Plain Woodland in the Sydney Basin Bioregion in Moderate/Good condition to be impacted (excluding certified areas)		42.09	11.67

As discussed above, in ‘Areas not requiring further assessment’ Grey Box – Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion – Low condition, was identified as having a site value score of less than 17. As such, impacts on this vegetation zone do not require assessment.

The project would result in a loss of 42.09 hectares of Cumberland Plain Woodland in the Sydney Basin Bioregion considered to be in moderate to good condition. This constitutes 0.13 per cent of the total remaining area of Cumberland Plain Woodland identified in the regional vegetation mapping and 0.4 per cent of the total remaining area of Cumberland Plain Woodland identified in the Final Determination for this community.

Most patches of Cumberland Plain Woodland within and adjoining the construction footprint are small, fragmented and contain no core habitat. Much of this vegetation is already situated adjacent to an existing cleared edge, often a road, and is subject to ongoing disturbance. As such, many of the areas of vegetation within and directly adjacent to the construction footprint are already subject to considerable edge effects, and additional indirect impacts are considered unlikely to substantially impact on these patches. An analysis of indirect impacts identified 11.67 hectares (including 7.03 hectares of revegetation) that may be indirectly impacted by edge effects from the project.

Mitigation measures are proposed in **Section 7.1.6** to manage impacts on this CEEC.

Species and populations

The project would not impact on any threatened species or population not previously recorded from the Cumberland IBRA subregion. There would also be no impact on a critically endangered species as a result of the project.

Critical habitat

There are no areas of land within the study area that the NSW Minister for the Environment has declared 'critical habitat' in accordance with section 47 of the TSC Act, and that are listed on the Critical Habitat Register in NSW (OEH, 2016c).

Matters of National Environmental Significance

MNES were considered as part of the impact assessment and include impacts on (EPBC listed) threatened species, migratory species and Commonwealth land. This is discussed in the following sections.

Impacts on threatened species listed under the EPBC Act

As identified above in **Table 7-19**, two EPBC listed threatened flora species are located within or in the immediate vicinity of the study area, these are:

- Sydney Bush Pea (*Pultenaea parviflora*)
- Spiked Rice flower (*Pimelea spicata*).

The proposed construction footprint requires the removal of 90 *Pultenaea parviflora* individuals. An assessment of significance concluded that this has the potential to significantly impact on this species.

No *Pimelea spicata* individuals would be disturbed as part of the project. However, 44 hectares of suitable habitat is currently planned to be removed. An assessment of significance concluded that this is not considered to be a significant reduction in potential habitat and therefore the project is unlikely to have a significant impact on *Pimelea spicata*.

One EPBC listed fauna species, the Grey-headed Flying-fox (listed as Vulnerable) was recorded foraging within the study area. The project would remove about 55.20 hectares of foraging habitat, which would impact on the sub-population that uses nearby camps and forages in the area. Given there are still significant foraging resources available within areas such as the Western Sydney Parklands and other locations in the study area the assessment concluded that the project is unlikely to significantly impact this sub-population.

Removal of TECs listed under the EPBC Act

The project would remove about 38.92 hectares of two TECs listed under the EPBC Act, as presented in **Table 7-22**.

The removal of 38.48 hectares of Cumberland Plain Woodland is likely to constitute a significant impact on the CEEC. Mitigation measures are proposed in **Section 7.1.6** to manage impacts on this CEEC.

The removal of 0.44 hectares of Western Sydney Dry Rainforest and Moist Woodland on Shale was considered unlikely to represent a significant impact on the community.

Table 7-22 Direct impacts on TECs listed under the EPBC Act within the study area

TEC name (EPBC Act)	EPBC Act status	Extent within study area (ha)	Area within construction footprint (ha)	Area within construction footprint, excluding certified area (ha)
Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest	CE	128.39 ha (includes 63.18 ha of revegetation)	45.96 ha (includes 20.21 ha of revegetation)	38.48 ha (includes 20.21 ha of revegetation)
Western Sydney Dry Rainforest and Moist Woodland on Shale	CE	4.97 ha	0.44 ha	0.44 ha
Total		**133.36**	**46.40**	**38.92**

Impact on migratory species

The study area does not contain any areas of important habitat for any of the listed migratory species. As such, while the project is likely to result in the loss of occasional habitat for migratory species, it would not impact on important habitat, and is unlikely to result in a significant impact on migratory species listed under the EPBC Act.

Commonwealth land

No work is proposed within Commonwealth land (ie Western Sydney Airport), and therefore no direct impacts are anticipated from the project. Potential indirect impacts from the project on the environment of Commonwealth land include air, construction noise, operational noise and visual impacts, provided in **Section 8.2.4**, **Section 7.7.6**, **Section 7.7.7** and **Section 7.4.4** respectively.

Impacts on aquatic habitat

Construction of the project would involve the following activities relevant to aquatic habitat:

- Installation of bridges is proposed at five creeks: Cosgroves Creek, Badgerys Creek, South Creek, Kemps Creek and Ropes Creek. As discussed in **Table 7-15**, four of the five creeks provide moderate fish habitat and key fish habitat according to field assessment and DPI mapping. Ropes Creek was assessed as unlikely fish habitat.
- Installation of pipe culverts are proposed at three waterways which were assessed as unlikely fish habitat, these being unnamed tributaries of South Creek, Cosgroves Creek and Ropes Creek.
- Permanent adjustments of Badgerys Creek, South Creek and Kemps Creek over a distance of 64 metres, 200 metres and 84 metres respectively.
- Potential installation of temporary waterway crossings for some or all waterways traversed by the project. The crossings are likely to comprise a temporary causeway built with rock and geotextile and pipe culverts to maintain flow.
- Temporary working platforms would be required at bridge sites to provide a working area for bridge pier and abutment construction including piling. These platforms would extend from the existing banks into the waterway to enable stable and safe access.
- Minor redirection of localised drainage lines as part of construction of the road, to facilitate flow through culverts and the introduction of specific discharge points from sediment basins.

Impacts on aquatic habitats may occur during construction as a result of the following:

- Instream works, including bridge and culvert construction
- Removal of aquatic vegetation and snags during creek adjustments and for culvert footprints
- Increased flow velocities in the local area and altered timing of water flows reaching creeks due to minor redirection of localised drainage lines
- Temporary work platforms could disrupt flow, detain water and increase inundation and disturb creek beds resulting in sedimentation downstream
- Changes in shading regime and temperature
- Potential for sedimentation and spills to affect water quality in the waterways.

As discussed in **Section 7.1.3**, no potential habitat for threatened fish listed under the FM Act and EPBC Act occurs within the study area or construction footprint, therefore no impacts on threatened fish are anticipated as a result of the project. Fish passage would be maintained at all creek crossings during the construction period. Although temporary crossings would potentially alter fish movement, fish passage would not be blocked. Culvert construction is unlikely to impact fish passage as the locations of all impacted waterways are unlikely to provide fish habitat.

The minor redirection of localised drainage lines during construction has the potential to slightly increase flow velocities in the local area and alter the timing of water flows reaching creeks. These alterations to local hydrology would not impact on aquatic species (eg fish), since this type of flow is ephemeral, but it may change microhabitat features for common frog species. This potential impact would be minor for these species that are adapted to a disturbed peri-urban environment.

Riparian vegetation would be removed over an area of about 4.35 hectares. Most of the vegetation to be removed is in poor condition. Removal of riparian vegetation would be minimised, and vegetation connectivity retained across the riparian zone where possible.

There is potential for sedimentation and spills to affect water quality in the waterways during the construction process which could also affect native fish and frogs, including downstream of the construction footprint. Implementation of appropriate sediment and erosion control procedures would be carried out to ensure high risk activities such as concrete pouring, mulching and earth works occur away from creek lines. Water quality mitigation measures provided in **Section 7.1.6** and **Section 7.9** during construction would minimise the likelihood and extent of potential impacts on creeks.

Impacts on groundwater dependent ecosystems

Potential GDEs are located around the creeks of the project and further to the east beyond the project (see **Figure 7-11**). At one location within the study area, about one kilometre east of The Northern Road, there is potential for construction activities to excavate below the water table, with a maximum draw down to groundwater in this area of about 1.6 metres (see **Section 7.10.4**). The closest GDE is about 240 metres from the base of the proposed cutting. On this basis the project is considered unlikely to impact on mapped GDEs.

As discussed previously, four PCTs have a moderate to high potential to depend on groundwater in the vicinity of the four creek crossings (Cosgroves Creek, Badgerys Creek, South Creek and Kemps Creek). Based on a worst-case scenario, vegetation underneath new bridges are assumed to be removed. However where possible, vegetation under bridges would be retained. Strategic native vegetation planting would be also implemented as part of landscaping of the project. In addition, groundwater at creek crossings would not be abstracted. Groundwater draw down is not likely to contribute to impacts on vegetation within the study area. Clearing of PCTs that may utilise groundwater is included in the assessment of native vegetation clearing discussed above.

Changes to hydrology

Alterations to the natural flow regimes of rivers and streams is recognised as a major factor contributing to loss of biological diversity and ecological function in aquatic ecosystems and is recognised as a Key Threatening Process (KTP) under the TSC Act. The following would have potential impacts on hydrology:

- Construction of bridges and culverts
- Creek adjustments
- Minor redirection of localised discharge lines.

These alterations to the local hydrology would have a negligible impact on aquatic species (eg fish), since this type of flow is ephemeral. However, it may change microhabitat features for common frog species. This potential impact would be minor for these species that are adapted to a disturbed peri-urban environment.

Further details on potential changes to hydrology are documented in **Appendix M**.

Fragmentation

The project has the potential to impact habitat corridors as follows:

- Reduce the area of vegetation comprising habitat corridors
- Reduce the width of habitat corridors
- Increase the width of existing gaps in habitat corridors
- Create new gaps in habitat corridors
- Introduce or move edge effects in corridors.

Two areas mapped as regional corridors would be impacted by the project:

- Woodland habitat along the eastern and western sides of the M7 Motorway
- Riparian Forest and adjacent Woodland habitat associated with Kemps Creek, South Creek and Badgerys Creek.

Mapped regional corridors within the study area are already highly fragmented by existing barriers including the M7 Motorway and Elizabeth Drive. Only one threatened fauna species, Cumberland Plain Land Snail, may be affected by further fragmentation of the riparian corridor along Badgerys Creek. However, the use of large-scale fauna corridors for this species is likely to be limited even when connected areas of suitable habitat are available. Other threatened fauna recorded or assumed present within the study area are highly mobile flying species. Therefore, the project is not anticipated to result in impacts on movement and/ or dispersal pathways for any threatened species or population.

Fauna injury and mortality

The primary cause of increased fauna injury and mortality during the construction stage of the project would be vegetation clearing at the start of construction. Less mobile, ground-dwelling species are at higher risk of mortality. Management measures to reduce the risk of accidental injury or mortality to fauna are proposed in **Section 7.1.6**.

Invasion and spread of weeds

Large areas of the study area have a high abundance of exotic species (see **Table 7-12**). Typically, weed invasion and spread is an indirect impact of projects that is often generated during construction by clearing vegetation and moving plant throughout the study area. Other project activities, including earthworks and movement of soil, can also result in the dispersal and introduction of weeds throughout the study area. Management measures proposed in **Section 7.1.6** would minimise the risk of introduction and spread of weeds.

Invasion and spread of pests

A total of 14 introduced vertebrate fauna species were recorded from the study area during surveys. In addition to the 14 exotic fauna species, two additional native species recorded within the study area, Noisy Miner (*Manorina melanocephala*) and Bell Miner (*Manorina melanophrys),* are also considered pest species.

Project activities (eg vegetation clearing, habitat removal, increased noise and human presence) have the potential to disperse pest species across the surrounding landscape and increase the ability of such species to utilise habitats during construction and operation phases due to vegetation clearing, habitat removal, increased noise and human presence. While the pest species listed above are likely to capitalise on the disturbance associated with construction and development activities, the project is unlikely to significantly increase the overall impact of pest species within the study area.

The aggressive exclusion of birds from potential woodland and forest habitat by over-abundant Noisy Miners was listed as a KTP under the EPBC Act. As project activities would increase fragmentation in the study area, it is likely that the project would increase the abundance of Noisy Miner in the study area and exacerbate this KTP.

Within the study area and construction footprint, there is also evidence of Bell Miner Associated Dieback (BMAD). This is caused by an overabundance of psyllids (sap-sucking insects that create a sugary excretion known as a lerp) in conjunction with Bell Miners (who feed on both the psyllids and lerp). As the project would result in further vegetation clearing and localised fragmentation, it could increase the prevalence and severity of BMAD in the locality. However, impacts are likely to be insignificant when compared to the broad-scale clearing that has occurred in the past as a result of agriculture and urban development.

Invasion and spread of pathogens and disease

Project construction has the potential to increase the spread of pathogens that threaten native biodiversity values. Pathogens specific to the project include:

- Soil-borne pathogen *Phytophthora cinnamomi* (Phytophthora)
- *Austropuccinia psidii* which causes the disease Myrtle rust
- *Batrachochytrium dendrobatidis* (Chytrid fungus)
- Psittacine beak and feather disease (PBFD).

All four of these pathogens are listed as KTPs under the TSC Act.

The project may increase the risk of dispersal of Phytophthora and Myrtle rust, from soil disturbance and plant movement during construction.

Chytrid fungus causes the infectious disease Chytridiomycosis (amphibian chytrid fungus disease) which affects amphibians. No threatened frogs are considered likely to occur within the study area, and chytrid fungus is therefore considered unlikely to have a significant impact within the study area.

As there are no threatened parrot species likely to occur within the study area, PBFD is unlikely to have a major impact within the study area.

The risk of these pathogens being spread because of the project would be minimised through a number of management measures which are provided in **Section 7.1.6**.

Noise, light and vibration

Fauna within and surrounding the study area would already be accustomed to noise associated with residential, light industrial and semi-rural areas.

Impacts from noise and vibration are likely to be localised to the construction footprint, existing roads and new roads. Construction noise is likely to create short term impacts on fauna, however remaining vegetation would provide refuges for fauna to retreat to, and impacts would be reduced after construction. These impacts are not considered to have a significant, long-term impact on fauna, including threatened fauna.

During night-time works there would be an increase in artificial lighting within the study area and surrounds. As such, the project may potentially affect nocturnal fauna by interrupting their life cycle or impacting on species that can be more vulnerable to predation (eg some small mammals).

Roads within the locality are currently lit and the existing M7 Motorway and Elizabeth Drive experience increased photo pollution due to heavy traffic and regular roadworks. Fauna within the area would already be adapted to photo pollution (on the M7 Motorway and Elizabeth Drive) and the increased artificial lighting associated with the project is unlikely to have a significant effect on fauna in the locality of the project.

Operational impacts

Fauna injury and mortality

It is anticipated that the primary cause of fauna injury and mortality at the operational stage of the project would be vehicle collisions. These are most likely to occur where the project intersects or is adjacent to large habitat patches and/or linear habitat corridors.

The most susceptible species are ones that are common, mobile and gregarious, such as arboreal mammals (eg Common Brushtail Possum) or larger terrestrial mammals (eg Eastern Grey Kangaroo and Swamp Wallaby). The main connecting links that would be impacted by the project align with the major creek crossings. All of these crossings are by way of bridge structures, allowing some level of fauna connectivity to remain in operation.

Clearing of canopy trees and installation of fencing for the project may result in additional barriers to habitat connectivity for common species such as the Sugar Glider and large macropods. However, fencing would be located to reduce road kill of fauna species and funnel animals to creek crossings where safe passage (including dry passage for terrestrial fauna) would be available.

Fauna passage would be available at the four main creek lines (Cosgroves Creek, South Creek, Kemps Creek and Badgerys Creek) underneath bridge structures.

Changes to aquatic habitat and hydrology

Bridges are proposed at the four creeks: Cosgroves Creek, Badgerys Creek, South Creek and Kemps Creek. All four creeks provide moderate fish habitat and key fish habitat according to field assessment and DPI mapping. Pipe culverts are also proposed at three of the unnamed tributaries which were assessed as unlikely fish habitat.

Badgerys Creek, South Creek and Kemps Creek would be permanently adjusted over a distance of 64 metres, 200 metres and 84 metres respectively. Creek adjustments would replace around 6366 square metres of key fish habitat in the channels with about 7452 square metres of newly created channels, partially compensating for the loss.

The proposed creek adjustments would maintain the existing creeks' channel capacity and would be designed and constructed in a way that mimics natural flow conditions. The creek adjustments are anticipated to have a neutral or beneficial impact on flow. The adjustments would reduce the risk of erosion around bridge piers, coordinate with bridge pier locations, minimise bridge lengths, provide suitable flood conveyance, reduce the number of times the creeks would be disturbed during construction, and assist fish passage. The creek channels would be rehabilitated at the completion of active construction work in accordance with the landscape plans for the project.

During operation there would also be a minor redirection of localised drainage lines to facilitate flow through culverts and the introduction of specific discharge points from water quality basins. As for the construction impact, this change has the potential to slightly increase flow velocities in the local area and alter the timing of water flows reaching creeks (eg as water is captured, settled then released from basins). This alteration of local hydrology would not impact on aquatic species (eg fish), since this type of flow is ephemeral, but it may change microhabitat features for common frog species. This potential impact would be minor for these species that are adapted to a disturbed peri-urban environment.

Shading regimes would be altered at the creek crossings as a result of bridge and culvert structures over small and limited areas of creeks along the footprint. However, this would not be significantly above what fish would encounter in riparian forest areas and it is likely to have only minor impacts on fish movements. Water temperature would be reduced in these areas compared with unshaded areas. However, this reduction would also be minor and form part of a mosaic of micro differences in water temperature along the creek lines.

Impacts on riparian corridors

Upon completion of construction, creek corridors would be revegetated with locally native riparian vegetation, in accordance with the requirements of the Policy and guidelines for fish habitat conservation and management (DPI, 2013) and Guidelines for instream works on waterfront land (DPI, 2012a). Revegetation would result in narrower gaps in riparian vegetation to mitigate impacts.

Revegetation under bridges would be carried out where possible to re-establish connectivity. Where revegetation under bridges is not possible or is not successful, gaps in riparian vegetation would permanently alter connectivity over short distances of the riparian corridors, affecting some terrestrial species that require continuity of vegetation for movement.

Noise, light and vibration impacts

Within the area of impact, some sensitive species (eg woodland birds) may avoid the noise, while some more tolerant species (eg small mammals) would habituate over the longer term.

The project would increase artificial lighting within the study area and surrounds during the operation phase. As such the project may potentially affect nocturnal fauna, but most local fauna would likely be already adapted to photo pollution (from the M7 Motorway and Elizabeth Drive). Therefore, increased artificial lighting associated with the project is unlikely to have a significant effect.

Noise, vibration and lighting impacts associated with the operation of the project are not considered to have a significant, long-term impact on fauna, including threatened fauna.

7.1.5 Cumulative impacts

Numerous projects in varying stages of delivery and planning are currently underway near the M12 Motorway corridor.

Table 7-23 identifies projects that are relevant both temporally and spatially to the project as they are located, or would be located, within the vicinity of the project and construction and/or operation may have overlapping timeframes.

Cumulative biodiversity impacts may arise from the interaction of construction and operation activities of the project and other approved or proposed projects in the area. When considered in isolation, specific project impacts may be considered minor. These minor impacts may be more substantial however, when the impact of multiple projects on the same receivers is considered.

In November 2018, the Commonwealth Minister for DoEE and NSW Minister for Planning and Public Spaces agreed on a strategic assessment of the proposed urban development of Western Sydney around the Western Sydney Airport to strike a balance between positive environmental outcomes and the needs of an expanding western Sydney population. The project is contained within the indicative map of the Strategic Assessment Area (Attachment 1 in *Environment Protection and Biodiversity Conservation Act 1999 – Part 10 Strategic Assessment – Section 146 Agreement for actions taken under the Cumberland Plain Conservation Plan* – "WSGC Strategic Assessment".

As part of the WSGC Strategic Assessment, the Cumberland Plain Conservation Plan (CPCP) is currently being drafted by NSW Department of Planning, Industry and Environment (Planning and Assessment) to guide strategic conservation planning of the development of Western Sydney. A draft of the CPCP is planned to be available for public comment in late 2019. The CPCP will identify how impacts on biodiversity from projected growth in Western Sydney would be addressed. The aim of the plan is to strike a balance between delivering positive environmental outcomes and supporting appropriate development for the next 37 years in western Sydney.

The CPCP is expected to take a holistic view of biodiversity of Western Sydney in its evaluation of over 200,000 hectares. The CPCP covers transport corridors around the Western Sydney Airport, but does not specifically include the M12 Motorway as part of its assessment within the area of the CPCP, there are four planned growth areas: the Greater Penrith to Eastern Creek Urban Release Investigation Area, the Western Sydney Aerotropolis, the Greater Macarthur Growth Area, and the Wilton Growth Area. the M12 is within the geographic range of the Western Sydney Aerotropolis.

TfNSW is a key stakeholder in the development of transport corridors to facilitate growth in these areas. As part of delivering appropriate biodiversity outcomes TfNSW were preparing for this growth by obtaining appropriate offset areas throughout this region. By taking a larger, strategic view of potential impacts, biodiversity values and offset requirements, strategic conservation planning sets out to minimise impacts on biodiversity within the western Sydney area as a whole.

The projects identified in **Table 7-23** would have significant cumulative biodiversity impacts associated with their construction and, at minimum, a moderate cumulative biodiversity impacts associated with their operation. A number of mitigation measures to minimise the contribution of the project to the cumulative impact are presented in **Section 7.1.6**. These measures include the preparation of construction-phase flora and fauna management plans, pre-clearance surveys, revegetation and the purchasing of offsets to address and manage the impacts identified in **Section 7.1.4**.

Further details of each of the projects considered is provided in **Table 7-3** and **Appendix E**.

Table 7-23 Cumulative biodiversity impacts

Project and status	Cumulative impacts
Western Sydney Airport Approved. Under construction	During construction, the Western Sydney Airport footprint is predicted to impact on about 280.8 hectares of native vegetation (GHD, 2016a). When considered alongside the 55.58 hectares of native vegetation in moderate to good condition to be removed for the project, the projects would together remove over 336 hectares of native vegetation, including threatened ecological communities and habitat for threatened species. There would be significant cumulative biodiversity impacts associated with the construction of the project and the Western Sydney Airport. The Western Sydney Airport and the project would be operational at the same time. As a result, impacts such as injury and mortality of fauna and noise, light and vibration may be greater than if the projects were operating in isolation. There would likely be, at minimum, moderate cumulative biodiversity impacts associated with the operation of the project and the Western Sydney Airport.

Project and status	Cumulative impacts
Sydney Metro Greater West Not yet approved	Construction timeframes for the Sydney Metro Greater West are likely to have some overlap with the construction of the project. During any timeframes when construction activities are concurrent, increased biodiversity impacts are likely. This would depend on the specific construction locations and the different construction activities, and the extent of biodiversity impacts. Although there are no details available on the biodiversity impacts of the Sydney Metro Greater West, given that the impacts of the project would be significant, it is likely that there would be significant cumulative biodiversity impacts associated with the construction of the project and the Sydney Metro Greater West. The Sydney Metro Greater West and the project would both be operational in the longer term (ie opening of the Metro may occur after the opening of the project). It is likely that there would be, at minimum, moderate cumulative biodiversity impacts associated with the operation of the project and the Sydney Metro Greater West.
The Northern Road upgrade Approved. Construction has begun	It is anticipated that about 2.4 hectares of remnant native vegetation and up to 3.9 hectares of planted vegetation along the M4 Motorway would be impacted for The Northern Road upgrade (Roads and Maritime, 2017a). A further 59.2 hectares of native vegetation is likely to be impacted between Narellan and Bringelly. When considered alongside the 55.58 hectares of native vegetation in moderate to good condition to be removed for the project, the projects would together remove over 121 hectares of native vegetation, including threatened ecological communities and habitat for threatened species. Given that the impacts of the project are significant, there would be significant cumulative biodiversity impacts associated with the construction of the project and The Northern Road upgrade Stages 5 and 6. The Northern Road upgrade and the project would be operational at the same time. As a result, impacts such as injury and mortality of fauna and noise, light and vibration may be greater than if the projects were operating in isolation. It is likely that there would be, at minimum, moderate cumulative biodiversity impacts associated with the operation of the project and The Northern Road upgrade Stages 5 and 6.
Other existing road network upgrades and potential road projects, including: • Elizabeth Drive upgrade • Mamre Road upgrade • Outer Sydney Orbital Not yet approved	The timing for construction of the above projects has not yet been announced. However, there is potential for overlaps in construction timing between the project and some of these road upgrade works. Although there are no details available on the biodiversity impacts of the other road network upgrades, given that the impacts of the project would be significant, it is likely that there would be significant cumulative biodiversity impacts associated with the construction of the project and other road projects. It is likely that there would be, at minimum, moderate cumulative biodiversity impacts associated with the operation of the project and other road projects
Major land releases, including: • Western Sydney Aerotropolis • South West Growth Area • Western Sydney Employment Area. Future strategic government project	The timing for the construction of developments within the above-mentioned growth areas has not yet been announced. There would be potential of overlaps in construction timing between some developments and the project. It is likely that there would be significant cumulative biodiversity impacts associated with the construction of the project and the development associated with the nearby growth areas. It is likely that there would be, at minimum, moderate cumulative biodiversity impacts associated with the operation of the project and the development associated with the nearby growth areas.

7.1.6 Environmental management measures

Measures to avoid, minimise or manage the project's impacts on biodiversity are detailed in **Table 7-24**. The measures would ensure that threat abatement plans (eg for affected EPBC Act listed species or ecological communities) are not compromised. This is relevant to the threat abatement plans that relate to pest species, weeds and pathogens.

Table 7-24 Environmental management measures (biodiversity)

Impact	Reference	Environmental management measure	Responsibility	Timing
All biodiversity impacts	B01	A CFFMP will be prepared. The measures in the CFFMP will include: • A site specific induction • Identification of clearing limits and exclusion fencing • Pre-clearance surveys • Vegetation clearing procedures • An unexpected finds procedure • Procedures for weed management and monitoring • A process for de-watering farm dams and the relocation of aquatic fauna • Provision of supplementary fauna habitat (eg nest boxes).	Contractor	Prior to construction
	B02	A Habitat Compensation Plan (HCP) will be prepared and implemented as part of the CFFMP for the project. The HCP will target those species that will be impacted by the loss of hollows. Measures will include: nest boxes, reuse of salvaged hollows and/or new technologies (eg chainsaw hollows), as well as replacement of woody debris and bushrock with consideration to Guide 5 and Guide 8 of Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011).	Contractor	Prior to construction
Removal of native vegetation, threatened species, and threatened species habitat	B03	Native vegetation, threatened species and threatened species habitat removal will be minimised where practicable through detailed design. This will include avoiding the nest and surrounds of the White-bellied Sea-Eagle, where practicable.	Contractor	Detailed design
	B04	Biodiversity offsets for the project will be purchased and managed in accordance with the Biodiversity Offset Strategy prepared for the project.	Roads and Maritime	Prior to operation
	B05	Pre-clearing surveys will be carried out in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011) (Guide 1: Pre-clearing process). The following species identified on or near the study area will require particular attention:	Contractor	Prior to construction

Impact	Reference	Environmental management measure	Responsibility	Timing
-		• White-bellied Sea-Eagle If design cannot avoid the White-bellied Sea-Eagle nest, then pre-clearing measures to avoid impact on the nest will be implemented. This will include pre-clearing survey to establish if it is currently being used and removal of the nest by an ecologist experienced in similar procedures. The potential impacts of habitat removal will be minimised by removing the nest outside of the nesting period (typically lays between June and September, with young remaining in the nest for 70 days). Time will be allowed on either side of the nesting period to allow individuals to select and construct a new nest site before clearing. • Cumberland Plain Land Snail Pre-clearance surveys will be carried out immediately before clearing works by a qualified ecologist in all vegetated areas to be disturbed that were identified as known or potential habitat for Cumberland Plain Land Snail (see **Figure 7-9**). As identified in the CFFMP, all individual Cumberland Plain Land Snails found during pre-clearance surveys will be translocated to adjacent areas of suitable habitat.		
	B06	An unexpected threatened species finds procedure will be developed as part of the CFFMP and based on Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011) (Guide 1: Pre-clearing process). The procedure will include requirements for workers to be made aware of the potential flora and fauna species that may be encountered during construction (including training staff on species identification) and outline the process for the identification and management of unexpected flora and fauna. In the event that any threatened species are identified during construction, the following steps will be carried out: 1. Stop work immediately in the location of the unexpected find to avoid any potential impacts. 2. Notify the environmental manager. 3. Environmental manger will arrange for an ecologist to conduct an assessment of significance of the likely impact, develop management options, and notify DPIE, EESG and DoEE as appropriate. 4. If a significant impact is unlikely to occur, rebegin work and maintain regular site inspections. 5. If a significant impact is likely to occur: a. Consult with DPIE, EESG and DoEE as appropriate. b. Obtain approvals, licences or permits as required. c. Rebegin work once advice is sought and necessary approvals, licences and permits are obtained. 6. Include species in subsequent inductions, toolbox talks and update the CEMP.	Contractor	During construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Removal of native vegetation and threatened species habitat	B07	Vegetation and habitat removal will be carried out in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011) (Guide 4: Clearing of vegetation and removal of bushrock).	Contractor	During construction
	B08	Revegetation will be carried out in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011) (Guide 3: Re-establishment of native vegetation) and the Landscape Plan prepared for the project.	Roads and Maritime/ Contractor	During construction
	B09	Habitat will be replaced or re-instated in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011) (Guide 5: Re-use of woody debris and bushrock and Guide 8: Nest boxes). A Habitat Compensation Plan, as described in B02 will include this measure.	Contractor	During construction
Riparian vegetation	B10	Removal of riparian vegetation at creek crossings will be minimised and vegetation connectivity across the riparian zone will be maintained where possible.	Contractor	During construction
Riparian vegetation and aquatic impacts	B11	Measures to protect aquatic and riparian habitat will be outlined in the CFFMP and protected in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects* (RTA, 2011) (*Guide 10: Aquatic habitats and riparian zones*) and Section 3.3.2 *Standard precautions and mitigation measures* of the Policy and guidelines for fish habitat conservation and management Update 2013 (DPI, 2013).	Contractor	Prior to construction
Aquatic impacts	B12	Creek adjustments will be investigated and removed or minimised during detailed design where feasible. Proposed creek adjustments will be designed such that they result in minimal changes to flow velocities.	Contractor	Detailed design
	B13	Creek corridors will be revegetated with locally native riparian vegetation, in accordance with the requirements of the Policy and guidelines for fish habitat conservation and management (DPI, 2013) and in consideration of the Guidelines for instream works on waterfront land (DPI, 2012b). The creek channels will be rehabilitated to preconstruction conditions or better.	Roads and Maritime/ Contractor	During construction
	B14	Bridge pier locations within instream (main waterway channel) or on creek banks will be avoided during detailed design at the South Creek, Cosgroves Creek, Badgerys Creek and Kemps Creek crossings. Where avoidance is not possible, further biodiversity assessment will be required.	Contractor	Detailed design
	B15	Large woody debris will be retained for creek crossing works where practicable. Any large woody debris placed in the realigned waterways will be relocated in consultation with an ecologist.	Contractor	During construction

Impact	Reference	Environmental management measure	Responsibility	Timing
	B16	Permanent and temporary waterway crossings will be designed and constructed to maintain fish passage in accordance with Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003). Crossing types should be matched to waterway type as per Table 1 in Fairfull and Witheridge (2003)	Contractor	During construction
	B17	The temporary application of mulch during construction will be managed to avoid the potential for material and tannin run-off into waterways. This will include limiting the application of mulch near waterways where practicable. The application of mulch for permanent landscaping must be designed and planned to avoid material and tannin runoff.	Roads and Maritime/ Contractor	During construction
	B18	Emergency response protocols and procedures will be included in the Project CEMP and implemented in the event of a contaminant spill or leak.	Contractor	During construction
	B19	Spill kits will be located to allow for the timely response to uncontained spills. Site inductions will include a briefing on the use of spill kits.	Contractor	During construction
Groundwater Dependent Ecosystems	B20	Interruptions to water flows associated with groundwater dependent ecosystems will be minimised through detailed design.	Contractor	Detailed design
Changes to hydrology	B21	Changes to existing surface water flows will be minimised through detailed design.	Contractor	Detailed design
Fragmentation of identified biodiversity links and habitat corridors	B22	Connectivity measures will be implemented in accordance with Wildlife Connectivity Guidelines for Road Projects (Roads and Maritime, under preparation). Fencing will be located to reduce roadkill of fauna species and funnel animals to creek crossings where safe passage will be available. Detailed design is to retain fauna passage at all four main creek lines (Cosgroves, South, Kemps and Badgerys creeks).	Contractor	Detailed design and during construction
Edge effects on adjacent native vegetation and habitat	B23	Exclusion zones will be set up at the limit of clearing in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011) (Guide 2: Exclusion zones).	Contractor	During construction
Injury and mortality of fauna	B24	Fauna will be managed in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011) (Guide 9: Fauna handling).	Contractor	During construction
Invasion and spread of pest species	B25	Weed species will be managed in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011) (Guide 6: Weed management).	Contractor	During construction
Invasion and spread of pathogens and disease	B26	Pathogens will be managed in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA projects (RTA, 2011) (Guide 2: Exclusion zones).	Contractor	During construction

Impact	Reference	Environmental management measure	Responsibility	Timing
Noise, light and vibration	B27	Shading impacts will be minimised through detailed design of bridge and culvert structures. The need for artificial lighting during construction and operation will be minimised through detailed design where feasible, including directing lighting away from vegetated areas where practicable.	Contractor	Detailed design, during construction

7.1.7 Biodiversity Offsets

Under the FBA, any residual impacts that cannot be avoided, minimised or mitigated, must be offset, with the offset requirements quantified as biodiversity credits as discussed in **Section 7.1.2**. The BOS provides greater detail regarding the potential mechanisms for meeting this offset obligation (Annexure D of **Appendix E**). The full credit report is provided in Annexure C of **Appendix E**. A summary is provided below.

For the project, ecosystem credits were calculated for six PCTs, all of which correspond with TECs under the TSC Act and/or EPBC Act. A total of 2568 ecosystem credits were identified as being required, comprising 2414 credits for direct impacts and 154 for indirect impacts.

Under the FBA, species can be either ecosystem species where their habitat is offset by the appropriate PCT credits, or species credit species requiring specific credits suitable for that species. Species credits were calculated for two threatened flora species (*Dillwynia tenuifolia, Pultenaea parviflora)* and two threatened fauna species (Cumberland Plain Land Snail, Southern Myotis) listed under the TSC Act and/or EPBC Act. A total of 5786 species credits were identified as being required.

A breakdown of the ecosystem and species credits required for the project are provided in **Table 7-25**, **Table 7-26** and **Table 7-27**.

Table 7-25 Summary of ecosystem credit offset requirements for direct impacts

PCT name	Total area directly impacted (ha)	Area impacted meeting EPBC TEC criteria (ha)	Total ecosystem credits required	Ecosystem credits required for EPBC TEC impacts
Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	6.91	4.86	372	276
Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	0.44	0.44	15	15
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	3.23	N/A – not listed	107	N/A
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	6.09	1.61	203	65

PCT name	Total area directly impacted (ha)	Area impacted meeting EPBC TEC criteria (ha)	Total ecosystem credits required	Ecosystem credits required for EPBC TEC impacts
Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	54.07	32.01	1650	1469
Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	2.53	0	67	0

Table 7-26 Summary of ecosystem credit offset requirements for indirect impacts

PCT name	Total area indirectly impacted (ha)	Area indirectly impacted meeting EPBC TEC criteria (ha)	Total ecosystem credits required	Ecosystem credits required for EPBC TEC impacts
Broad-leaved Ironbark - Grey Box - *Melaleuca decora* grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	0.52	0.52	7	7
Forest Red Gum - Grey Box shrubby woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	0.54	0.54	5	5
Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion	0.24	0.24	3	3
Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin Bioregion	11.43	11.33	139	138

Table 7-27 Summary of species credit offset requirements

Species name	TSC Act status	EPBC Act status	Threatened species offset multiplier	Loss of habitat (ha) or individuals	Species credits required
Dillwynia tenuifolia	V	-	1.8	244 individuals	4392
Pultenaea parviflora Sydney Bush-pea	E	V	1.5	90 individuals	1350
Meridolum corneovirens Cumberland Plain Land Snail	E	-	1.3	1.86 ha	24
Myotis macropus Southern Myotis	V	-	2.2	0.92 ha	20

Impacts on threatened species listed under the FM Act are unlikely and therefore do not require offsets. However, impacts on KFH are to be offset. The offsets for aquatic habitat are limited to the area of KFH impacted and are considered separately from impacts offset under the FBA.

Regions, Industry, Agriculture and Resources (RIAR) Group of the Department of Planning, Industry and Environment (DPIE) (former Department of Industry) (2013) calculates habitat compensation on a minimum 2:1 basis for all KFH lost; a greater compensation ratio may be considered if offsets cannot be sourced in the vicinity of the impact or are not of the same habitat type as that impacted. The cost per square metre would be confirmed with NSW RIAR Group of DPIE, but for the purposes of this assessment the current rate is estimated to be $55 per square metre. Based this current rate, a 2:1 offset ratio and proposed revegetation and designed creek capability, about 5281 square metres of KFH would still be required to be offset, which would cost about $290,455.